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Pouring Molds by an Ingenious Method

A New Device for Handling and Casting Metal Introduced by the Brillion Iron Works — Another Step in the Elimination of Manual Labor

FOR nineteen years the Brillion Iron Works has operated a shop at the little town of Brillion, Wis., for the manufacture of agricultural implements and special attention has been given to the production of clod crushers and field rollers. The principal feature of the crusher is a roller from 5 to 10 feet long and 12 to 18 inches in diameter, consisting of a number of discs or plates, each about 2½ inches thick. The peripheries of the plates are concaved so that when they are mounted in series on a shaft, the surface of the resulting roller is corrugated. The manufacture of thousands of plates annually requires extensive gray iron foundry facilities. At the present time the Brillion Iron Works is melting from 12 to 15 tons of gray iron per day in a new shop 240 feet long and 60 feet wide. The total molding floor area is approximately 14,400 square feet, giving slightly over 950 square feet per ton of output daily. This compares favorably with the practice of other agricultural implement foundries.

Early last year the company was confronted with the problem of increasing its production without making extensive additions to the plant. This situation was met by the purchase of a number of molding machines from the Arcade Mfg. Co., Freeport, Ill. The first machine was bought on Jan. 15, 1913, and by October seven more had been added to the equipment. Most of the machines are

FIG. 1—DETAIL OF POURING LADLE

FIG. 2—GENERAL ARRANGEMENT OF BRILLION POURING APPARATUS

FIG. 3—EACH MAN POURS SEVEN MOLDS IN 65 SECONDS

of the squeezer type, operating with compressed air. After the machines had been in service for a while it was found that their output was limited by the ability of the molders to pour off their floors at the end of the day. The average weight of the castings produced does not exceed 15 pounds each, and the metal was poured from hand ladles according to the practice usually followed in malleable and light gray iron foundries. It was necessary to stop molding early in the afternoon in order to leave sufficient time to pour the heat.

Inasmuch as a still further increase in production was necessary, it was decided to try and improve the pouring methods. This problem was given considerable study by Henry Ariens, president and general manager of the company, and in consequence of his investigations a mechanical pouring device was invented. The early results of its operation were exceedingly gratifying, the increase in production being over 20 per cent. With their traditional conservatism, the molders at first were opposed to the new method of pouring, but after a few days' trial they found it involved so much less work that now they could not be induced to return to their hand ladles. Therefore, although the device was invented primarily to increase production, it has created a more satisfied body of workmen and has improved labor conditions. With the aid of the pouring device, the molder does not have to carry any iron; the heavy weights which are usually handled are all borne by cranes or trolleys.

FIG. 4—FILLING THE POURING LADLES FROM THE BULL LADLE

How the Iron is Handled

The apparatus consists essentially of a bull ladle trolley suspended from an I-beam monorail which extends the full length of the shop, passing every floor. Each floor or bay is equipped with a small, easily operated hand crane which runs across the shop at right angles to the monorail. The hand cranes carry small ladles from which the molds are poured. The bull ladle is electrically-driven, and since the cupola is located at the middle of the shop, it makes alternate trips to each end of the building. An operator rides with the bull ladle and controls the filling of the small pouring ladles. The latter are handled entirely by the molders who not only

FIG. 5—A FLOOR OF ROLLER PLATES AND END FRAME MOLDS

pour-off the floors, but also shift their own weights and clean up the scraps of iron which may be spilled. The general arrangement of the system is clearly shown in Fig. 2, while Fig. 1 gives detailed view of one of the pouring ladles.

Using this device, one man easily pours 175 molds containing 18-inch roller plates weighing 16 pounds each, including sprues. The total weight of metal poured is, therefore, approximately 2,800 pounds. An even greater number of smaller flasks can be poured. Owing to the fact that the bull ladle makes alternate trips to each end of the shop, the men have ample time to shift their weights and rest during the pouring period. The bull ladle carries 2,000 pounds of iron and the small pouring ladles have a capacity up to 300 pounds each. The molds are poured in rows commencing with the one farthest from the bull ladle. There usually are seven flasks in each row and after they are poured, the workman shifts the weights forward to the next row during the interval when the bull ladle is at the other end of the shop.

Rapid Pouring

In a few observations made on Feb. 12, it was found that a green molder poured seven flasks containing 15-inch plates in 65 seconds. The total weight of metal handled in this time was approximately 90 pounds. About 25 seconds were required to fill the ladle and shift the hand crane to the proper point for pouring; 65 seconds were absorbed by the pouring operation itself and 70 seconds more in shifting weights and returning the pouring device to the bull ladle. When pouring by hand, the men were able to carry only enough iron to fill three molds and a helper was necessary to shift the weights. If there is any iron left in the pouring ladle it is not wasted, but is allowed to remain in the ladle and become mixed with the next batch of new hot iron from the bull ladle. The pouring ladles are of sufficient size to make this procedure practicable.

The hand cranes which carry the pouring ladles may be of any convenient span up to 20 feet. At the Brillion Iron Works these cranes have a span of 15 feet and a height of 8 feet from the floor. The latter figure could be increased to 12 feet with

FIG. 6—ELECTRICALLY-OPERATED BULL LADLE TROLLEY

safety. The hand cranes consist of simple roller bearing trolleys from which a 5-inch I-beam is suspended.

The ladle yoke is hung at the lower end of a 1¼-inch pipe, as indicated in Fig. 1. The ladle itself, which is 12 inches high and of equal diameter, is carried in a bail, to the shaft of which the tilting lever is attached. The yoke slides over the suspension pipe and rests on a large cam which is held in position by a pawl. When the pawl is released, the yoke and ladle may be raised or lowered a distance of 10 inches by operating a lever connected to the cam. When receiving metal from the bull ladle, the pouring ladle is dropped to its lowest position and is afterward raised to any height convenient to the operator, within the range of the device. A sheet metal shield which is secured to the yoke, over the ladle, screens the molders' eyes from the intense glare of the hot iron. This results in more accurate pouring and fewer spills, thus reducing accidents and burns to a minimum. The men also appreciate the relief from eye strain.

The Ladle Trolley

The electrically-driven bull ladle trolley, which was furnished by the Pawling & Harnischfeger Co., Milwaukee, has a capacity of 4,000 pounds. It is suspended from a 9-inch I-beam and is steadied at the bottom by a trailing wheel. A 2,000-pound, geared ladle is carried. The machine is driven by a 4-horsepower reversing motor. The details of this device are clearly shown in Fig. 6, which also illustrates the cupola and sheet metal hood for carrying away smoke and fumes. For emergency use, the Brillion Iron Works also has a hand-operated bull ladle trolley.

Fig. 3 shows how the floors of 15 and 18-inch roller plates are poured. The Arcade air squeezers on which the plates are molded may be seen in the background. The 18-inch plates weigh 14 pounds finished and 16 pounds with the sprue. They are molded in 20-inch, two-part cast iron flasks, the drags being 1½ and the copes 4½ inches in depth. Two machines are used, one for molding copes and the other for making drags. The machines are moved back across the floor as the sand is consumed and the molding progresses. When they have to cut over their own sand, two men put up an average of 150 molds each per day; if the sand is cut and tempered by a helper, the production of the machine operators is increased to 175 molds per man per day. The figures given below were taken from the records of the Brillion Iron Works, and show the actual production of a man between Feb. 3 and Feb. 11, 1914. Eighteen-inch roller plates were molded on a No. 10 air squeezer, and in each day about an hour's time was required in the morning to cut over and prepare the sand. The record follows:

Date.	No. of molds.	No. spoiled.
Feb. 3	132	0
Feb. 5	150	4
Feb. 6	126	1
Feb. 7	150	3
Feb. 9	150	2
Feb. 10	150	3
Feb. 11	150	4

Another record, making 15-inch plates, follows:

Date.	No. of molds.	No. spoiled.
Feb. 2	175	4
Feb. 3	175	3
Feb. 4	175	11
Feb. 5	175	10
Feb. 6	161	8
Feb. 7	154	4
Feb. 9	158	2
Feb. 10	171	9
Feb. 11	175	1

The 12-inch plates are molded in a similar manner, the drags being made on a No. 10 Arcade air squeezer and the copes on a No. 13 machine. The flasks are 16 inches in diameter, the drags being 1½ and the copes 3½ inches in depth. The castings weigh 8 pounds finished and 9½ pounds in the rough. Two men, one to each machine, put up an average of 400 flasks per day and their losses average 2 per cent. It is expected that this production will be increased by fitting up the machines so that both parts of the flask can be squeezed at one time. In this case, the sprue pattern is so fitted to the head of the machine that it cuts through the cope when the latter is squeezed.

Fig. 5 shows a floor of end-frame molds which are cast in snap flasks 30 inches long, with an average width of 11½ inches. The pattern plates and bottom boards from which these castings are made are shown in the foreground in Fig. 5. A finished casting weighs 23 pounds and two men put up 65 molds per day, using Modern molding machines. Before the machines were purchased, the production by hand was 25 molds per day and the losses were considerably heavier than they are at present.

Melting Equipment

The iron is melted in a No. 5 Whiting cupola which has been lined to an inside diameter of 42 inches. The average melting ratio for 1913 was 7 pounds of iron to 1 pound of coke. Sufficient coke is put in the bed charge to bring the first layer of iron 18 inches above the tuyeres. The regular charges consist of 2,000 pounds of iron and 250 pounds of coke. The average mixture consists of 1,800 pounds of returned sprues, 17,075 pounds of No. 1 cast scrap, including some steel, and 4,725 pounds of northern high phosphorus pig iron. Pig iron makes up only about 20 per cent of the total mixture. The drop from the cupola is put through a cinder mill every day and from 600 to 700 pounds of iron are recovered.

In addition to the foundry, the plant of the Brillion Iron Works includes a machine shop for the manufacture of stationary gasoline engines, an assembling department, a paint shop and a shipping room. Power to operate the machinery is furnished by an 80-horsepower, vertical 4-cylinder kerosene engine built by the John Lauson Mfg. Co., New Holstein, Wis.

Iridium

Iridium belongs to the group of platinum metals, six of which usually are found associated, with platinum predominating. The six metals include rhodium, palladium, ruthenium, iridium, asmium and platinum. All of the platinum metals are gray and have high atomic weights and melting points. Platinum ore usually contains 50 to 80 per cent platinum, up to 2 per cent palladium, up to 7 per cent iridium and asmium and ruthenium, 1½ per cent each. Occasionally the iridium is found in the form of grains alloyed with osmium and mixed with the platinum ores. When in this condition, the osmium is separated easily from the other platinum metals as the latter are soluble in *aqua-regia,* which only slightly attacks the asmium-iridium alloy. The grains of osmium-iridium are hard and malleable and make good pen points. Iridium also is hard in alloy with platinum in the proportion of 10 parts of iridium and 90 parts of platinum. This alloy is attacked only silghly by *aqua-regia.*

When iridium is extracted from platinum ores it usually is left in the form of a black powder after the platinum has been dissolved by the wet method. The powder then is heated with phosphorus in a silica crucible to convert it into a phosphide which can be fused to a liquid. The next step is to remove the phosphorus, which is accomplished by heating the iridium phosphide with lime and this leaves a white, brittle mass of metallic iridium so hard that it cannot be cut or filed, but can be broken with a hammer. Metallic iridium is used largely for pointing gold pens, the small pieces broken by hammering being gold-soldered to the pen points, later being shaped and polished by grinding with carborundum.

Side Lights on the Foundryman's Difficulties

A Few of the Problems Which the Shop Executive and the Molder Must Contend With Every Day

By S R Stowe

FOR years the foundryman has had things said to him in reference to the bad castings he makes, that would lead to the belief that he is different from other men who try to do things, that he is not as successful in his efforts as other tradesmen are in theirs, and in many instances that he is far below what he should be in getting uniform results. In fact, in being depended upon to know that his work will be perfect, he is a sinner above all sinners. I think this has been so from time immemorial.

Superintendent's Cold Logic

Can any foundryman recall the time when the superintendent would not start something like this: "I could never understand, Mr. Foundryman, why your branch of the manufacturing industry cannot measure up to the standard of excellency attained by other departments. You foundrymen never seem to be sure of anything. It seems to me that if a molder knew his business as well as he should and can make a mold that gives a good casting today, he should be able to do the same thing, in the same way, and get the same results tomorrow and the day after and the day after that and so on 'World without end'. Why, look at the machine shop, or pattern shop, especially the machine shop. A man can learn to drill a hole or turn a piece or do work on his planer and do it the same every day, and it is very unusual that he fails in these things. But your man has lost three of those air comp' cylinders out of 100 in the foundry and two more were junked in the machine shop because the cores that make the intake valve seat would not true-up in finishing within 3/64 inch on one, and the other showed a leak in the heavy section around the discharge port. I wish you would look into this matter and try to overcome it as much as possible. The fact that 95 were perfect would seem to indicate that the job was not a difficult one and that some of your men were careless. I hope you will give this your prompt attention."

Having spoken in his most impressive tone, he looks over his eye glasses and walks away, carefully noting that he has left the impression of his superior wisdom on poor Mr. Foundryman, who, while not being able perhaps to reply in well-chosen words, feels within himself that although the cold logic of the argument against him was perhaps correct, yet there was something wrong in its application and that the comparisons made were at fault. And right here let us observe that foundry practice was never improved by any superior leaving such an impression on a subordinate. If Mr. Superintendent would think it part of his job to inquire into the conditions that surround his workmen in the foundry and elsewhere, he would soon recognize that they all have problems to solve that require the best that is in any man in his own station from the greatest down to the least. And if he would take time to analyze his own line of talk he would discover it to be full of error. To begin with, not even the most radical believer in foreordination would go so far as to say that it was predestined that the foundry "was the inheritance or promotion of fools".

Let us see if Mr. Molder and Mr. Foundryman differ so greatly, after all, from other men. To say that a machinist can repeat the operation of drilling or turning or planing indefinitely, with uniform results, is not making a strong case against the ability of the molder, for the operations mentioned are only details in the work of building a machine, as an engine for instance. I can as consistently say that a molder can set his pattern in his flask—set his gates and cut them, set his gaggers, set his cores and many other details—each day in the same manner.

Is the Machine Shop Infallible?

Mr. Superintendent speaks without thought and does not believe what he says, for if he did he would remove all his testing blocks and utilize his testing room for other purposes, and never waste time testing another machine or engine before shipping it to the customer; because, you see, he has built some engines that are perfect enough to ship. This being so, why can't he, in the light of his own logic and wisdom, be sure all will be the same? But no man fit for the position would be foolhardy enough to do such a thing. The machine shop takes the rough castings for the engine to be built, machines them, assembles them, believes them to be right, runs them into the testing room, turns on the steam or gas as the case may be, and, behold, they move not—sometimes—and sometimes they run backwards. Anyhow, after some loosening here and tightening there, some resetting of valve or eccentric, some cutting of the piston or shimming of the rod-head, the whole thing goes. This sometimes takes a day or more. Now, all this is looked upon as a normal shop condition, and all I ask is the same thing for the foundry.

Difficulties of the Molder

The molder starts out to make a mold, perhaps he works one day on it or perhaps a week, gets it ready for coring, spends a day or two doing that and often has to get the gas off a core as big as a piano, through a hole as big as a lead pencil that is in the center of a projection of sand no bigger than a silver dollar, and then not directly out, but must connect this vent through another core set up on stool chaplets and entirely surrounded by metal, except one or two outlets about the size of a quarter, and to make it still easier (?) for the molder, the casting has one side so thin that the iron must be poured as hot and fast as it can be handled, for it must be poured hot enough to run the thinnest parts perfectly. Again these cores may be in a depth of mold that requires them to sustain a static pressure equal to a column 6 or 7 feet high, and if any of our tackle or devices used to secure mold or cores yield to this pressure enough to let iron that is poured fit to run fine tooth combs, into the vent around which there is 1½ or 2 inches of a margin, why of course it was carelessness.

Of course all these small details do not amount to much (?), to a man whose only conception of molding is a hole to dump iron into.

When a molder finishes a large mold and gets it ready to pour, he

thinks he has done all that he can do to make it safe and sure. In other words, he believes his machine or engine will run, and as the crane brings up his iron to pour, he is then at a point of progress in his work that seems to me to correspond very nearly to the machinist when he turns his form of energy into his engine. The one turns in steam or gas, the other turns in melted iron. The machinist may note the behavior of his test and remedy any errors, as noted elsewhere in this article.

But the molder is not so fortunate in this. His test is a destructive test. He cannot shut off his steam or gas and change anything. It may be days before he can know how his test proved his work to be. Any one of the parts that had to be readjusted on the engine to make it right would perhaps cause a bad casting if a corresponding error was made in molding. Not long ago I saw a large engine being started after repairs. After it was thought to be right it took several hours to "Make her go". Several things were not as they should have been as proven by the changes that had to be made. All of them could have been foreseen just as plainly as most things that go wrong to make a mold give a bad casting, and yet it was taken as a matter of course.

Now to say that if everything is as it should be the result will be a success, is not settling the problems that enter into perfect work in any department. I often regret that some of the men who are not foundrymen had not made a choice of that profession. Some of us who have been trying to improve in that line would gladly sit at their feet. Isn't it too bad that the men who know it can be done, don't know how to do it? We poor fellows who know the difficulties involved do not seem to have the ability to overcome them even after years of patient and more or less intelligent endeavor, and yet the writer knows of several shops and believes there are many who do not lose over 4 to 6 per cent of their work. If the work of the whole world was even 75 per cent perfect, I guess it would be pretty good.

Superintendent of a Different Kind

All superintendents are not as described. The writer has personal and intimate knowledge of one who understands what the writer has sought to bring out in this article, in other words, that there are real difficulties in the foundry, as elsewhere; that molders are not different from other mortals essentially. That in the foundry as in other departments, the human factor is always present. This superintendent enjoys the reputation of having the most loyal gang in his part of the state, of turning out a superior product in his line, and his shop is usually busy (employing 300 to 450 men) when other shops are idle. Concerns have been willing to pay him a fancy price for his castings, because the defects in the machine shop were so low as to warrant it, and yet his foundry makes some bad castings. He is, however, a man who cleaned castings when a lad, and afterward learned the machinists' trade, then becoming foreman, superintendent and part owner. He does not claim to know much about the foundry, but he has an abundance of common sense. I find that few have trouble with men who have been seasoned in the ranks before taking a high position, and when you come to think of it, how can some of the "Young 'uns" be expected to know these things? Some of them are fresh from college. They are well equipped in everything but experience and a knowledge of men and things, and if they can get over the humps safely they will perhaps be o. k. But just the same they make it very uncomfortable for the ones under them, in trying out ideas that would no doubt work under laboratory conditions, but those conditions are not present in the shop.

Infinite Wisdom

To say that the molder should be sure of perfect work always, is to demand of him a wisdom almost infinite. All around me I see more or less failure in all human endeavor. Days and weeks are spent in digging up a sewer because of faulty design or construction. The mortar in brick walls disintegrates and will soon render the walls unsafe. Walls for sand bins prove too frail to support the burden and fall; chains, slings, hooks and other tackle show defects in welding, and so on. Patterns come to the foundry with core prints mislocated or actually forgotten. Flasks come from the machine shop with pins and pin plates off center enough to be useless until changed. Changes are made in core boxes and corresponding changes are not made in patterns to meet them. I have known a job to be sent as many as four times to pattern or machine shop to be changed before it was right.

I am not reciting all of this to give a black eye to any branch of work, but simply to show that "everybody's doing it". We should assume that every honest workman is striving to attain a fair degree of excellency, and that he will succeed in his effort more or less as that effort is made along the lines of honest, intelligent endeavor, and in proportion to the encouragement he has received in his field of work, the molder is no worse than the average man.

And in conclusion I will add that I know of no other industry where so much has been expected from so frail equipment and poor material, as from the foundry.

Volume of Air Required for Melting

By W. J. Keep

Question.—We have been experimenting with the different blast pressures on a cupola lined to 42 inches. We have obtained the best results with a high blast pressure giving 3,400 or 3,500 cubic feet of air per minute, and we are melting 7½ tons of iron per hour. We are of the opinion, however, that the lining will not withstand this rapid melting.

Answer.—If it requires 30,000 cubic feet of air to melt a ton of iron, you should expect seven tons per hour. However, you are doing a trifle better than this in a small cupola. The only problem, however, is the lining. The tuyeres in your cupola are practically continuous and they should deliver the air over so large an area that the force of the blast cannot reach the wall opposite the point where it enters. If the blast cuts your lining, it will be more economical to keep up the lining than to melt a smaller amount of iron. With a cupola lined to 62 inches and melting 14 tons per hour, we obtain the best results with 18 ounces blast pressure and it was found that we melted more than a ton of iron to 30,000 cubic feet of air and our melting ratio with a 30-ton heat was better than 9 to 1. However, you cannot expect to do as well as this with a cupola lined to 42 inches. We are convinced that speed and fuel economy is to be preferred to a slight increase in the cost of lining repairs.

The necessity for larger space and better facilities to handle their increased business compelled the Indianapolis and Louisville branches of the H. W. Johns-Manville Co., New York City, to seek larger quarters. The Indianapolis branch now is located at 408-410 North Capitol avenue and the Louisville branch at 659-661 South Fourth avenue. Both of these branches have ample warehouse accommodations.

Promoting Safety in Grinding Wheel Work

How Steel Hoods Can Be Used to Advantage on Grinding Machines, With Suggestions for Other Safety Measures

THE dangers of grinding wheel operation and how they may be overcome are pointed out in a bulletin recently issued by the committee on safety and sanitation of the National Founders' Association. The bulletin states that the speed of the ordinary grinding or emery wheel is as great as that of a fast express train and traveling at a rate of approximately 1 mile a minute, the wheel is subject to frequent alternations of no duty and severe duty. During one moment it may be running idle, in the next it may sustain violent shocks in rapid succession as it attacks the irregular fins of a casting or plows through a solid mass of metal.

The grinding wheels which perform this severe service are composed of a multitude of gritty particles, artificially bonded together. Manufacturers have attained remarkable results in strongly uniting these particles; the elements of the bonding process, however, cannot be controlled with such accuracy as to insure absolute safety of every wheel, and, in spite of most careful inspection and test, grinding wheels sometimes burst. Yet it must be conceded that the majority of such accidents are due to abuse of wheels in service and not to faulty manufacture.

Varied work conditions require the use of wheels of many shapes and degrees of hardness and fineness of grain. Plain wheels are obviously of stronger construction than cup wheels or other special shapes; hard wheels are of stronger composition than soft ones. Hence plain and hard wheels may be safely run at higher speeds than cup or special shaped wheels and soft grades. It has, therefore, become the custom of grinding wheel manufacturers to attach a label to each wheel, indicating the safe maximum speed of that particular shape and grade of wheel; these recommended speeds should never be exceeded.

To secure greatest efficiency of grinding wheels, it is desirable to operate them at the safe maximum speeds; most machines, therefore, are equipped with cone pulleys offering two or more speeds to equalize the wheel's cutting efficiency. The dangerous drawback of this arrangement lies in the fact that the belts on such machines may be shifted by men who do not realize the danger of overspeeding, and yet overspeeding is a frequent cause of the bursting of grinding wheels. Moreover, when a small wheel is replaced by a large one, the operative is apt to neglect to return the belt to its proper position, thereby producing an excessive, unsafe speed.

Safety devices can be installed, with comparatively small expense, to successfully overcome these hazards. On a machine equipped with a two-step cone pulley, a belt-locking device automatically controlled by the diameter of the wheel in use, as shown in Fig. 3, will take care of the problem of excessive speed as well as that of using oversize wheels. When the cone pulley has three or more steps, the belt may be secured in proper position by the belt lock shown in Fig. 4, while the use of an oversize wheel is avoided by attaching an adjustable wheel-limit stop, also shown in Fig. 3. A sign attached to the machine stating the revolutions per minute by the use of each step is of much value.

Some managers use single speed machines equipped with permanent wheel-limit stops, as shown in Fig. 3,

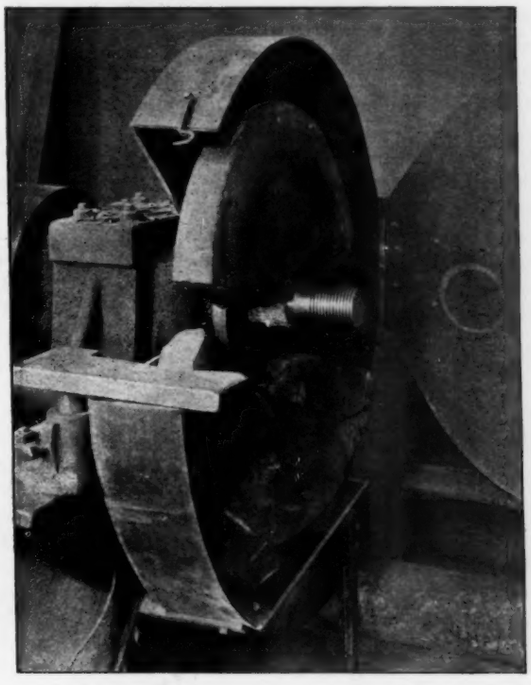


FIG. 1—PROTECTIVE VALUE OF STEEL HOOD WHEN GRINDING WHEEL BROKE

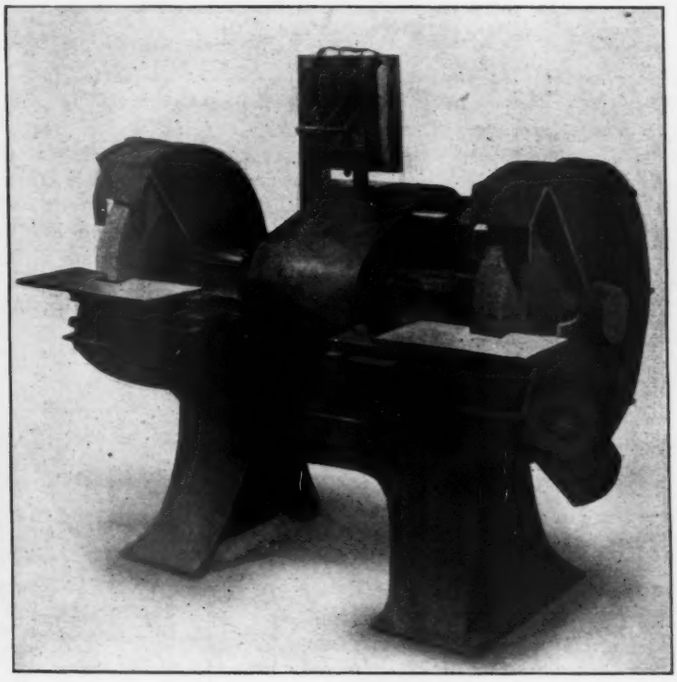


FIG. 2—MOTOR-DRIVEN GRINDER SAFEGUARDED WITH STEEL HOODS

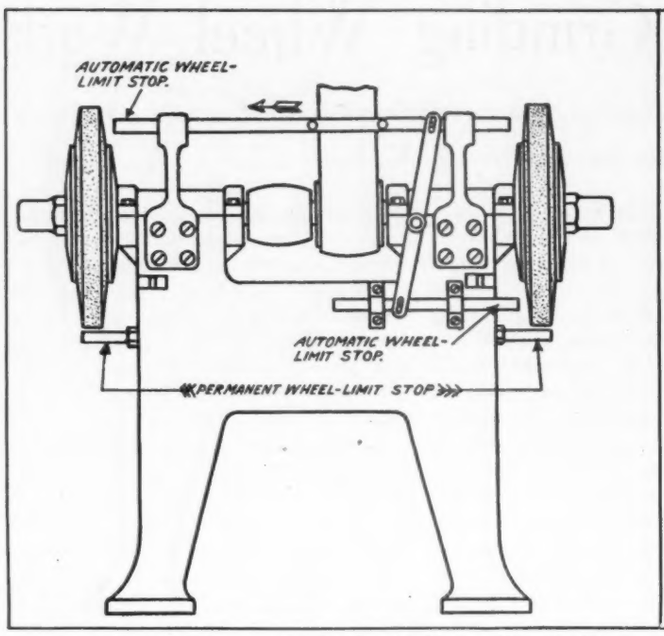


FIG. 3—BELT-DRIVEN GRINDER EQUIPPED WITH AUTOMATIC WHEEL LIMIT STOP

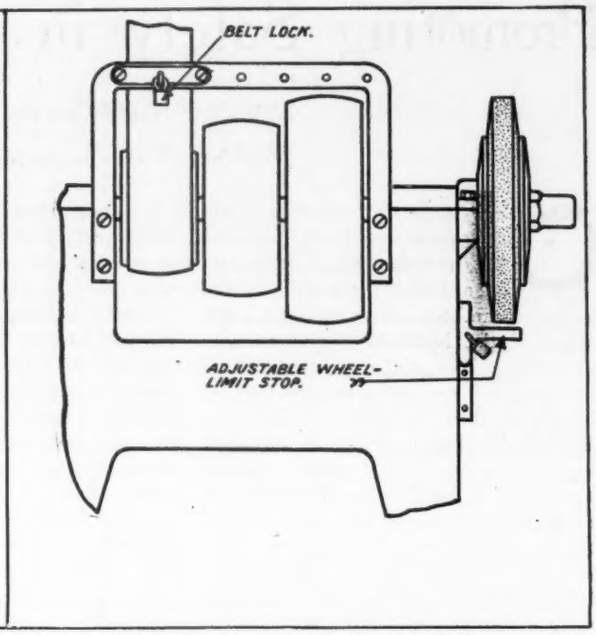


FIG. 4—GRINDER EQUIPPED WITH AN ADJUSTABLE WHEEL LIMIT STOP AND BELT LOCK

and are content to thus sacrifice efficiency in order to gain safety. In other plants, however, where a number of machines are used for one grade of work, single speed grinders, each of different speed, are used and wheel-limit stops are provided; maximum efficiency is maintained by transferring wheels successively from low to higher speed machines as the wheels wear small. When single speed machines are equipped with protection hoods of the right diameter, these limit the size of wheel used, and other wheel-limit stops are unnecessary.

Wheel Too Heavy for Spindle

When a grinding wheel is too heavy for its spindle, the latter will run out of true and may break; this may prove as disastrous as breakage of a wheel. The accompanying table gives spindle diameters which reputable grinding wheel manufacturers recommend for various sizes of wheels.

Before mounting a grinding wheel upon its spindle it is well to examine the wheel for cracks; a cracked wheel, when lightly tapped with a hammer, will not ring clear. The wheel should slide on the spindle easily, but not too loosely, as the wheel would then run out of balance; if forced on tightly, the wheel is apt to be broken. A clearance of 0.005 inch is considered satisfactory.

Excessive heating of bearings and shaft should be avoided by frequent careful adjustment and by use of automatic grease cups or self-oiling bearings, amply protected from dust and grit.

It is advisable to confine within flanges as much of the wheel as is practicable, and it has been generally agreed that wheels covered by flanges less than one-half the diameter of the wheels are unsafe; where feasible, the wheels should not be allowed to project more than 2 inches beyond the flanges, in which case several sizes of flanges are used to suit the reduced size of the wheels.

The clamping action of flanges

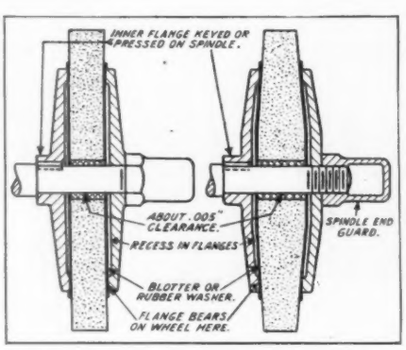

INNER FLANGE KEYED OR PRESSED ON SPINDLE.
ABOUT .005" CLEARANCE.
RECESS IN FLANGES
BLOTTER OR RUBBER WASHER.
FLANGE BEARS ON WHEEL HERE.
SPINDLE END GUARD.

FIG. 5 — PROPER MOUNTING OF STRAIGHT AND SAFETY WHEELS

should be effective at their circumference in order to compress the wheel at the outer edge of the flanges and not at the center, for which purpose the flanges should be recessed toward the center. Flanges which are not recessed clamp the wheel only where the nut compresses near the center. Steel flanges are more dependable than cast iron flanges.

Both inner and outer flanges should be of the same diameter, in order to prevent straining of the wheel. When flanges of one diameter are used exclusively, the inner flange should be pressed securely on the spindle; when flanges of various diameters are used on the same spindle interchangeably, all inner flanges should be keyed. This is necessary to provide a true bearing for the side of the wheel and to prevent a tendency of the nut to creep.

To obtain uniform pressure of flanges upon the rough sides of the wheel, washers made of soft blotting board or of 1/16-inch sheet rubber should always be used between the flanges and wheels; they should be slightly larger than the diameter of the flanges. Blotting board washers are suitable for light service; rubber washers, while a little more expensive, make better cushion contact between flanges and wheels and hold the wheel more securely.

Danger in Tight Nuts

When finally the wheel is secured upon the spindle by the clamping nut, care should be taken to tighten the latter only enough to hold the wheel firmly; otherwise the clamping strain is apt to crack the wheel.

If either the wheel or the frame of the machine should vibrate abnormally after the wheel has been thus carefully mounted upon a spindle of proper diameter, and operated at normal speed, the cause may be found in weak foundations, an unbalanced wheel, imperfect bearings or shafts, or the machine itself may be too light for the weight of the wheel it carries.

Abnormal vibration is apt to shatter the wheels and this hazard must be promptly removed.

Wheels are usually in good balance when they are shipped from the factory. They, however, are subject to greater wear at some points than at others; dressing tools also dig more deeply into soft spots than into harder parts of the wheel. They should be dressed and trued at frequent intervals. The dressing tool itself should be of the guarded type. Grinding wheels should be kept in a dry place. Wheels used for wet grinding should not be allowed to stand idle in water, as the heavy water-soaked or damp portion of the wheel throws it out of balance.

Use of Protection Hoods

Eeven though operating conditions may be good, grinding wheels nevertheless sometimes do break in service, because they are of brittle composition and subject to much abuse. Protection hoods, therefore, should be provided to hold within safe bounds the broken parts of a grinding wheel in case it should break; sometimes the use of safety wheels will mitigate the danger.

Safety grinding wheels usually are tapered on both sides; they are clamped between tapered steel flanges, concaved to fit snugly the tapered sides of the wheels. To insure accuracy of fit, which is very important, safety flanges and safety wheels should be furnished by the same manufacturer.

While safety wheels have prevented many injuries, they are not absolutely dependable. The unbalanced momentum of a broken wheel is often sufficient to spread the flanges and allow broken parts of the wheel to escape. Moreover, even safety flanges cannot retain broken pieces which may fly from the unconfined rim of a grinding wheel. Safety wheels are chiefly desirable in special cases when the character of the work absolutely prohibits the use of hoods, and even then extraordinary care must be taken to maintain favorable operating conditions and moderate speeds.

A protection hood is the best and safest method to guard against injuries from broken grinding wheels. When possible the hood should be of such construction as to serve also as a dust hood which, when connected with a suitable exhaust system, will eliminate the injurious effects of grinding wheel dust and at the same time protects against accidents.

Such combination hoods are regularly made and form a part of modern machines; it has also been found practicable to install such hoods upon old machines.

Cast steel or rolled steel hoods are safer than cast iron hoods; the latter are not dependable, except for light wheels which are rarely used in foundries. Hoods should be amply strong to serve their purpose. The inside diameter and width of the hoods should be sufficiently larger than the corresponding diameter of the wheel to allow proper clearance. The hood should also enclose the spindle end, but if the character of the machine will not allow this, a separate guard can be provided as illustrated in Fig. 5, to prevent workmen's clothing from catching in the spindle threads. The hood should enclose the wheel as much as possible and leave an opening only large enough to satisfactorily apply the work to be ground. If the opening is too large it will permit the escape of broken parts of the wheel and thus frustrate one important purpose for which the hood is designed; it will also require greater volume of air for proper exhaust.

Grinding dust should be carried away by an adequate exhaust system. Where this cannot be done, the eyes of operatives should be protected from the sharp and injurious grinding and metal dust by approved eye protectors. Sometimes an adjustable glass shield is used, arranged to slide in a metal frame attached to the machine.

For safe and convenient handling of work while it is being ground, grinding wheels are usually provided with work rests; these must be adjustable and workmen should be encouraged to keep them as close as possible to the wheel, for otherwise the workmen's fingers may be drawn between the wheel and work rest or pieces of the casting or even the casting itself may become wedged in the opening and do damage to the wheel or to the workman or to both. The clamps for fastening the work rest in place must be effective in their action, so that work rests may not be forced away from the wheel at a critical moment.

In order to avoid striking of hard blows on sides of wheels when handling heavy or cumbersome castings, a chain hoist will prove an economical investment; by its use castings may be safely held while workmen guide the castings against the wheel; or suitable tables or rests can be devised for the same purpose.

Wherever belts are used on grinding wheels they should be enclosed in suitable guards constructed of sheet iron, expanded metal or heavy wire screen, attached to angle iron frames; sometimes wooden guards are used, because more economical, and, when properly made are of protective value. The belts should be guarded to a height about 7 feet above the floor.

To prevent stumbling against the machine, the floor about the machine should be kept free from castings or other obstructions.

The foregoing recommendations are adaptable to machines now in use. If, however, new machines are to be installed, it is advisable to insist that they be equipped with every safeguard. Grinding machines are mostly of the belt-driven type. Electrically-driven machines are now finding increased use; they are usually equipped with constant speed motors, which, together with protection hoods and devices to limit the size of grinding wheels, give safe conditions of operation. Some manufacturers equip their machines with variable speed motors in order to maintain maximum operating efficiency; such machines should have devices to guard against overspeeding, for instance, through automatic connection between the motor speed regulator and the diameter of the grinding wheel.

In the case of portable or swing-frame grinding machines, it is equally important that all practicable protecting devices should be provided; in all cases protection hoods can be applied and provisions can be made against overspeeding.

TABLE OF SMALLEST SPINDLES FOR VARIOUS SIZES OF GRINDING WHEELS

Diameter of wheel.	Maximum Thickness of Grinding Wheels, in Inches.												
	1	1¼	1½	1¾	2	2¼	2½	3	3½	4	4½	5	5½	6
8	¾	¾	¾	¾	¾	¾	1	1	1	1	1¼	1¼	1¼	1¼
9	¾	¾	¾	¾	1	1	1	1	1	1¼	1¼	1¼	1¼	1¼
10	¾	¾	¾	1	1	1	1	1	1¼	1¼	1¼	1½	1½	1½
12	¾	1	1	1	1	1¼	1¼	1¼	1½	1½	1½	1½	1¾	1¾
14	1	1	1	1¼	1¼	1¼	1¼	1½	1½	1¾	1¾	1¾	1¾	1¾
16	1	1¼	1¼	1¼	1½	1½	1½	1¾	1¾	1¾	1¾	1¾	1¾	2
18	1¼	1¼	1¼	1½	1½	1½	1¾	1¾	1¾	1¾	2	2	2	2
20	1¼	1¼	1½	1½	1¾	1¾	1¾	1¾	1¾	2	2	2	2	2¼
22	1¼	1½	1½	1¾	1¾	1¾	1¾	2	2	2	2	2¼	2¼	2¼
24	1½	1½	1¾	1¾	1¾	1¾	2	2	2	2	2¼	2¼	2¼	2½
26	...	1¾	1¾	1¾	1¾	2	2	2	2	2¼	2¼	2¼	2¼	2½	3
28	...	...	1¾	1¾	2	2	2	2	2¼	2¼	2¼	2¼	2½	3	3
30	...	...	1¾	2	2	2	2	2¼	2¼	2¼	2½	3	3	...
32	...	...	2	2	2	2	2¼	2¼	2½	2½	3	3	...	...
34	...	...	2	2	2	2¼	2¼	2½	2½	3	3	...	...	...
36	...	...	2	2	2¼	2¼	2¼	2½	3	3	...	...	...	...

How Manganese Steel Castings Are Made

Details of Molding, Melting and Pattern Making Practice in Shops Specializing on Manganese Steel

By F R Zerhansen

ALLOY steels for special purposes where extreme toughness, strength or ability to withstand shock is desirable, are now being made in large quantities. Various rare metals are used to combine with the steel, including nickel, titanium, vanadium and manganese. The latter has been found specially suitable for castings which are subjected to severe abrasive wear and a number of large manganese steel foundries are now operating in various sections of the country. Their combined output ranges from 55,000 to 65,000 tons a year and single castings weighing up to 13 tons are now being made regularly.

Refining the Metal

In making manganese steel castings, the metal is refined in a Bessemer converter from which it is poured into a ladle in which the proper quantity of melted ferro-manganese has been previously added. The manganese acts as a strong scavenger, removing oxygen and other gases and impurities from the metal, leaving it homogeneous and dense. Either a standard Bessemer or a Tropenas or other modified type of converter may be used to refine the steel. In fact the melting equipment is precisely similar to that necessary for the production of unalloyed converter steel castings. Similar raw materials, including low phosphorus pig iron and selected steel scrap are used. The castings, of course, will be improved if special care is used in selecting the raw materials. From a metallurgical standpoint, there is nothing to prevent the successful production of manganese steel in open-hearth furnaces and it is possible that there may be some developments in the future along this line, although at present the converter process is strictly adhered to in this country.

Commercial, 80 per cent ferro-manganese forms the basis of the alloy. It is melted in crucibles and most shops use oil-burning furnaces of the standard Milwaukee type. In these furnaces, the oil is burned in pans under a natural draft and the crucibles are protected from breakage due to irregular temperatures. Recently some experiments have been made in melting ferro-manganese in an air furnace burning oil or coke and it is understood that they have been unusually successful. This method makes it possible to melt the alloy more economically than when crucibles are used, in spite of the fact that a melting loss is introduced.

The quantity of manganese required varies somewhat with the nature of the castings although 12½ per cent is a good average figure. To produce castings that will show this amount of manganese upon analysis, it is necessary to add about 312 pounds of standard 80 per cent ferro-manganese to each net ton of steel. This is done, as previously stated, by placing the melted alloy in a hot ladle before the steel is poured from the converter. After the steel has been added to the alloy, the ladle is allowed to stand for a few minutes to permit the ferro-manganese to perform its function, after which the excessive accumulation of slag is removed by skimming.

The principles of ordinary steel foundry practice apply in making the molds for manganese steel castings except that due allowance must be made for the unusual shrinkage of the metal. This amounts to 5/16 inch per foot whereas ordinary steel shrinks only about 3/16 inch. On this account special care must be given the patternmaking in order that the castings will not be undersize. It is also necessary to use special care to properly distribute the metal in the mold so that unusual cooling strains will not be introduced. Abrupt changes in section are particularly undesirable. In many cases an allowance is added to the pattern and the metal is afterward ground off before the casting is ready for shipment.

Molding Practice

The actual molding practice is similar to that practiced in ordinary steel foundries. The molten metal has a severe cutting action which makes it necessary to use sand containing a high percentage of silica and for the same reason, the molds are usually oven-dried although in some cases skin-drying is sufficient. The cores are made in the usual manner except that the excessive shrinkage must be taken into account. The molds are gated and provided with shrink-heads as for ordinary steel castings. In many cases the castings are molded vertically, using a goose neck gate so that the metal enters from the bottom. This is done to avoid segregation, a defect toward which manganese steel is specially disposed.

Heat Treatment of Manganese Steel

In their heat treatment, manganese steel castings are handled entirely different from ordinary metal in that they are quenched suddenly in cold water when removed red hot from the annealing ovens. Some of the castings, of course, need a preliminary treatment to remove cooling strains and in these cases they are taken from the sand while still hot and slowly cooled in an oven, after which they are reheated and quenched. Ordinarily, however, they are allowed to cool and then are annealed from three to 26 hours at temperatures ranging from 1,800 to 2,000 degrees Fahr. At the conclusion of this process, they are quenched.

The annealing ovens are constructed in the usual manner and are designed to burn coal, coke or oil. The larger ones are provided with cars on which the castings are placed and in some cases arrangements are made so that the cars may be deposited bodily with their loads in the quenching tanks.

Unannealed manganese steel castings are exceptionally brittle and almost as hard as glass. After the heat treatment they are tough and ductile with a tensile strength of about 90,000 pounds and an elastic limit of 60,000 pounds per square inch. The ductility of the metal is shown by the elongation and reduction of area which frequently amount to 28 and 29 per cent, respectively.

It is now possible to anneal manganese steel castings up to about 5½ inches in thickness. Mill pinions and other large castings, therefore, are cored-out so that the metal will not be too thick for proper heat treatment.

After the castings are annealed they are cleaned and finished, using swing grinders and other special emery wheel equipment. Castings which must be accurately finished cannot be machined by ordinary methods on account of their toughness, but must be ground to size.

Dry Sand Blower Casing Mold

By W D Fraser

The general run of our cast iron work is comparatively light, although during the past few years we have made quite a few intricate castings. Among these were two fan casings with attached motor bases, which, at first gave us considerable trouble as the casing was only 5/16 inch thick while the base averaged about ¾ inch.

We decided to mold the casings in dry sand and used the following mixture for a facing 2 inches thick all over the pattern: Sixteen parts of Jersey fire sand; 16 parts of Albany No. 4 molding sand; one part of dry core compound, tempered with glutrin and the core boxes; *A* and *B*, the base, had to be divided on account of drawing the pattern from the mold and *C*, the casing shell, was split in the center. Figs 3 and 4 show the casting partly machined. It is about 4 feet 6 inches in diameter and the base is approximately 4 feet square and weighs 1,150 pounds.

For pouring, we attached a two-ton chain hoist on our traveling crane directly over the pouring basin on the casing. We first tapped the iron into a 1,200-pound trolley ladle, then ran this back on the track until directly underneath the chain hoist; while our regular crane ladle was being filled at the cupola spout, we hoisted the first ladle clear from its trolley and when high enough placed both ladles in position and poured about 600 pounds into the light section first; then we started to pour from the crane ladle on top of the base, which was gated at the bottom and half way up, and poured from both ladles until about 50 pounds of iron overflowed. Upon uncovering our first casting the next morning it split across the light sections; the second casting, therefore, was left in the sand two days and we had the satisfaction of getting a good, clean, casting which machined up in fine shape.

I would like to have the opinion of some of the readers of THE FOUNDRY with reference to molding these casings in green sand, or molding the base section in the drag.

FIG. 1—PATTERNS AND CORE BOXES FOR FAN CASING
FIG. 3—CASING MOUNTED ON A PLANER

FIG. 2—THE MOLD FOR THE CASING
FIG. 4—CASING, SHOWING MOTOR BASE

Patterns for Repetition Work

Frequently a wood pattern is made for an experimental job and if the device works satisfactorily, a metal pattern will be produced subsequently for the manufacturing operations. However, it is a frequent occurrence that no time is allowed the patternmaker to produce the metal pattern, with the result that the wood pattern or patterns are used until they practically fall apart and then complaints are received from the machine shop head that the castings are not coming as they were at first and the explanations of the patternmaker fall on deaf ears. While the foundryman usually is the first party censured for bad work that reaches the machine shop, nevertheless he usually falls back on that ever-present haven of safety in time of trouble—the patternmaker. On the latter's shoulders he promptly throws all the blame for poor castings from wet sand, bad iron, improper vents,

tuyere troubles, disagreeable weather conditions, etc.

Recently we had occasion to make a hurry-up wood pattern for a job that we hoped would be the last word in our line and it so happened that the device was a winner from the start. To prevent the loss of time in placing it on the market, the hurry-up pattern was used to produce castings for manufacturing and everything went lovely for a time. As a matter of fact, we had even forgotten to make another pattern, when suddenly we were advised that some of the castings were so badly bent out of shape that they could not be finished. The foundry foreman merely pointed to the pattern and told us that it was his model for the molds he was making and if it was not right the problem was not up to him. He graciously admitted, however, that it was rather inopportune to make a kick on the pattern, inasmuch as he had made several hundred bad castings with it. Yet in spite of this fact he insisted that nothing else could be done than to put the proposition up to the patternmaker and he offered to send for the pattern to prove that he was not at fault. This was done and one could never guess what actually had happened. An investigation showed that some of the last castings made were satisfactory, while others were not, yet they were all produced from the same pattern.

After looking into the situation carefully we found that in the morning the bench molder would start his day's work with a dry pattern, but as he made each succeeding mold, the pattern being shy of varnish on the end grain, would absorb moisture from the damp sand and would continue doing so 25 times a day, as this constituted the number of molds put up. Approximately the last seven castings would be unfit for use, due entirely to the fact that the pattern had absorbed enough moisture to pull it out of shape and the castings did not have enough finish allowance to true them up. The explanation, of course, was simple, for when the pattern was new and covered with varnish the moisture did not affect it materially, but as the varnish wore off the pattern absorbed moisture each time it was molded until at the end of the day it was warped out of shape. During the night the pattern dried out and again was in good shape for use in the morning.

Making Taper Cone Pulleys

Two unusual gray iron castings, recently produced by the Union Foundry Co., Fitchburg, Mass., are shown in the accompanying illustration. They are taper cone pulleys of the double arm, split hub type, designed for transmitting power to a large paper-making machine, for which a variable speed drive is required. Each pulley weighed 5 tons, was 4 feet in diameter at one end and 5 feet at the other, and the length of the pulley face was 10 feet. The thickness of the metal in these castings averaged 1 inch.

CAST IRON, TAPER CONE PULLEYS MADE BY UNION FOUNDRY CO., FITCHBURG, MASS.

These pulleys were cast in loam in a circular iron flask, 70 inches in diameter and 11 feet high, which was rammed up in a pit, 9 feet deep. Two weeks were required to complete each of the molds and one ton of sand and 1,500 bricks was used in each.

The cheek, which was made first, was dried in an oven, 15 feet high, 13 feet deep and 10 feet wide. While the cheek was drying, the core was built-up on the floor of the pit. The core weighed 9 tons, while the completed mold weighed 16 tons.

The arms, which were hollow, were made by placing a solid, dry sand core inside of a hollow dry sand core, and were located in the loam core at the proper height. The mold was poured from the top. A riser was provided, which extended 6 inches from the top of the mold. As shown in the illustration, the risers have been cut-off the castings.

Permanent Molds

By W. J. Keep.

Question.—We are contemplating the use of permanent molds to make small castings and we would like to know what mixture should be used for these molds to insure the making of a maximum number of castings from them.

Answer.—If the molds are large, use a very soft iron, that is, a mixture containing comparatively little combined carbon. The question of carbon, however, is not so important with small molds, as their rapid heating will convert the combined carbon into graphitic and this will swell the mold approximately ¼ inch per foot, while soft iron will not effect such a change. The life of the mold also will be prolonged considerably if it is coated after each cast with crude petroleum.

Link Belt Data Book

The Link-Belt Co., Chicago, has recently published an engineering data book which contains information that will enable the users of power to select the correct type of silent chain drives for their work and also determine the cost from list prices shown in the book. Besides giving complete engineering information on silent chain driving in a simple and compact form, that data book, No. 125, describes many uses of silent chain for the efficient transmission of power and gives illustrations showing its application in a large variety of cases.

Silent chain as manufactured by the Link-Belt Co. consists of series of links connected by joints which contain segmental case-hardened bushings and case-hardened steel pins. Its rated efficiency is 98.2 per cent. Data from over 200,000 installations, it is understood, were drawn upon for the information contained in the book.

The book consists of 112 pages and is bound in a flexible red cover. Copies may be obtained free of charge from the Link-Belt Co., Thirty-ninth and Stewart avenue, Chicago.

The Boston branch of the National Metal Trades Association, 141 Milk street, Boston, is compiling a file of catalogs for the use of its members and would be pleased to receive booklets, catalogs and other printed matter from manufacturers.

Reducing Casting Cost of Ornamental Bronze

How the Standard Practice in the Foundries of the National Cash Register Co. Has Been Revolutionized

By Samuel Wilson

FOUR years ago the methods employed in the brass foundries of the National Cash Register Co., Dayton, O., were fully described in THE FOUNDRY. At that time the equipment of this plant included only three or four molding machines, whereas today the inventory shows machines of the Tabor, Mumford, Berkshire, Lawlor, United States and Adams types. Nor is this the only change in practice. Four years ago bronze work was cast almost entirely in dry sand, the molds having been double-faced; today 98 per cent of the bronze is cast in green sand with a single facing.

Such a complete revolution in methods has not been accomplished without a great deal of experimentation, however, the major part of which was disappointing in its outcome. Robert S. B. Wallace, foreman, says that these improvements merely are the result of an unwillingness to continue forever to do a certain thing in a certain way with the single excuse that grandfather did it that way and scored a success. It has been his experience that not more than one in six attempts to improve on an existing method ever survives the experimental stage. But this one success ordinarily will return much more than the cost of the six experiments. As a matter of fact, this "looking for a better way" is a striking characteristic of the National Cash Register plant. The workman who sees a better way, or thinks he sees a better way, has no hesitation about calling it to the attention of his foreman. Perhaps this accounts, in a small measure, for the noteworthy success of this great institution.

E MOLDING MACHINE FLOORS, SHOWING THE MOLDS ONLY SLIGHTLY TILTED FOR POURING

While this foundry casts 31 non-ferrous alloys, by far the greater part of the work is the production of ornamental bronze. Of this there are three grades or classes, based on color. In this work, strength, within reasonable limits, is of little or no importance. Exact color, perfection of finish, and good machining qualities are the requisites. The fact that considerable variation in strength in no wise detracts from the value of the finished casting, has led to numerous experiments in varying the composition of the alloys, to the end that material costs may be reduced. Figs 6, 7 and 8 give a fair idea of the class of work made. These illustrations show various patterns, not mounted on plates, but cast with the plate in one piece. The permanency of patterns and plates so made is obvious. Moreover, it is almost a guarantee of accuracy both in mold and in finished piece. While this practice would probably be too costly for most jobbing foundries, the large number of duplicate pieces required makes it an entirely practicable plan, and accounts for a considerable increase in machine output, as well as a reduction in the loss on imperfect castings.

Figs. 7 and 8 show the method of mounting a somewhat intricate part. In Fig. 8 is shown a device for drawing an inside lug without the use of cores. The side on which the lugs appear has some taper and for many years the piece was cast with the lugs extending to the back plate. While this added only a small amount to the cost of each part, the number of parts was so great as to warrant some study. The simple device shown in

FIG. 2—THE METAL WEIGHING ROOM, SHOWING THE CHARGING BOXES
FIG. 4—THE METAL PATTERN AND PATTERN PLATE DEPARTMENT

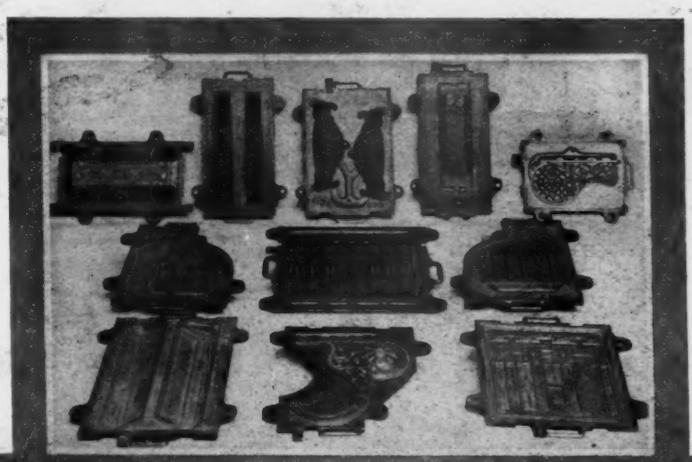
FIG. 3—ONE OF THE COMBINATION JAR AND SQUEEZE MOLDING MACHINES IN THE BACKGROUND AND A FLOOR OF MOLDS
FIG. 5—THE CASTING CLEANING DEPARTMENT

Fig. 8 was the result. By means of the lever, the lugs may be withdrawn without disturbing the mold. The spring keeps the lugs in place while the mold is being rammed.

Fig. 4 is a general view of the department and equipment devoted to the casting of patterns and pattern plates. Here, the patterns are made, mounted on pattern plates and a casting of the pattern and plate is made. In finishing these plates, strict accuracy is observed, as the cost of this initial work is small in comparison to its total effect on the piece cost of the regular product. Here again this foundry differs widely from a jobbing concern, in that within the widest limits any money spent on improving patterns is wisely spent, while in the jobbing foundry it is oftentimes economy to work with somewhat troublesome patterns when the quantity of castings required is small. Of the entire output of this foundry, ornamental bronze work constitutes at least four-fifths. Probably less than 10 per cent of this is hand-molded. By the employment of machines, by the discontinuance of the double-facing of molds and by pouring the molds flat, it has been possible to effect a saving of nearly 40 per cent calculated on the basis of metal prices remaining stationary. This is the more remarkable in view of the fact that, during this same period 150 men who are working by the day have had their daily wage increased 25 cents.

The general floor arrangement of one section of the shop and the location of the molding machines is shown in Fig. 1. As in standard practice, the machines are arranged along the wall near the windows and the floors extend back toward the center of the building. The heap sand used is No. 0 and No. 1 Albany. In order to keep the sand open, the men are required to add about 5 per cent of new sand daily. To insure this being done, the required amount of sand is delivered daily to each floor and dumped on the heap. All of the machines are equipped with pneumatic vibrators and pattern-drawing devices.

Fig. 3 is a closer view of one of the jar and squeeze machines and shows some of the machine-made molds. In the background is a somewhat intricate gate necessitated in pouring flat, a large, open frame. The machine operator at the left is shown in the act of drawing the pattern. The lever in his hand operates a double cradle lifting device which draws the mold away from pattern, the pattern meanwhile being gently vibrated. The practical application of a mechanical device for drawing the pattern has been found to greatly relieve the operator of the machine and to increase the output. The elements of such a mechanism are as follows: Four movable pins extend upward through the table of the machine. The height of the top of these pins must be adjustable. This may be accomplished by having a thread cut on the upper ends and using a pair of lock-nuts on the top of each pin. These four pins must then be raised and lowered uniformly by a hand-operated, parallel motion mechanism, placed under the table of the machine. The tops of the four pins contact with the face of the pattern plate, and when raised, lift the mold from pattern. The parallel motion device used in this foundry consists of four cradle arms, two of which are mounted on the same shaft with the hand lever shown in Fig. 3, while the other two are mounted on a parallel shaft symmetrically located on the other side of the machine. The cradle arms on the hand-operated shaft engage those on the other shaft so that the outer wings of the four arms raise and lower in unison. Of the many features of the standard practice in this foundry, that of pouring the work flat is worthy of particular emphasis. When it is remembered that most of the pieces are flat, thin plates, the metal which is saved in pouring in this way instead of upright, is best realized. The position of the molds ready for the metal is shown in Fig. 1. It will be noted that they are set at an angle of about 15 degrees to the floor. As the necessary thickness of some of these plates is only one-tenth of an inch, the reduced metal pressure with the molds setting at a small angle



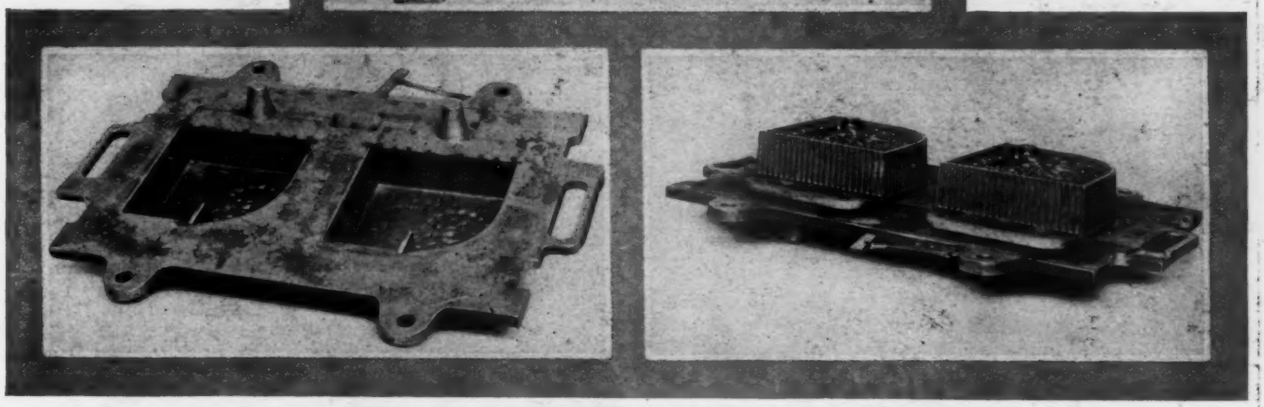


FIG. 6—A FEW OF THE THOUSANDS OF METAL PATTERN PLATES IN USE

FIG. 7—PATTERN PLATE EQUIPPED WITH DEVICE FOR WITHDRAWING LUGS, THEREBY ELIMINATING CORES

FIG. 8—ONE OF THE INTRICATE PATTERN PLATES

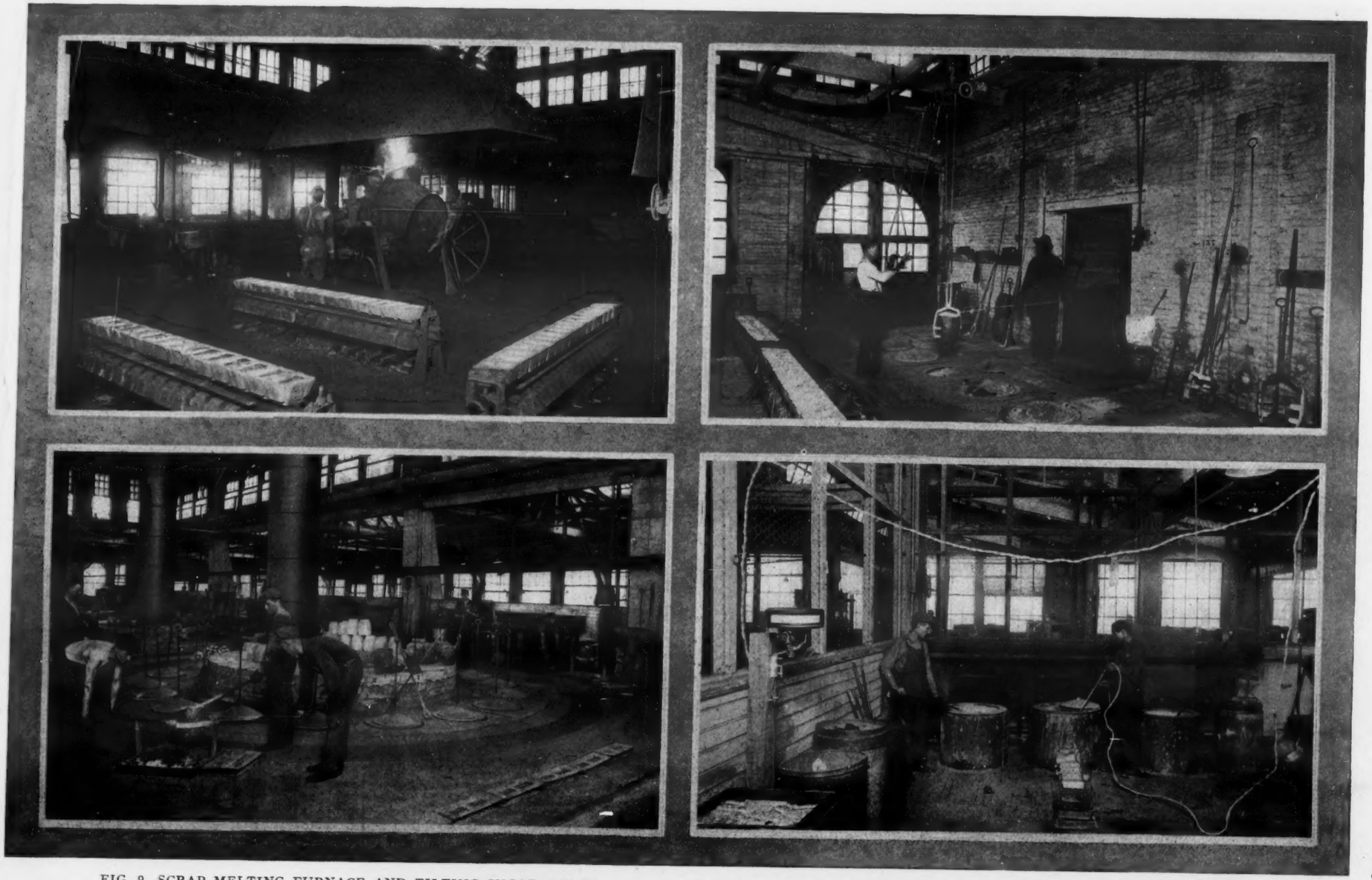


FIG. 9—SCRAP MELTING FURNACE AND TILTING INGOT MOLDS
FIG. 11—ONE OF THE COKE-FIRED, CRUCIBLE-FURNACE, MELTING FLOORS

FIG. 10—CRUCIBLE FURNACES FOR MELTING SCRAP, SHOWING HOIST AND TROLLEY FOR HANDLING THE POTS
FIG. 12—WHITE METAL MELTING FURNACES, SHOWING MELTER USING A PYROMETER

instead of vertical so lessens the swell on the lower end of the plate as to make a material reduction in weight and metal cost. Although Fig. 1 shows only a few floors in one of the two foundries, it is nevertheless ample proof of the daily success of flat pouring with green sand molds.

During average days, this foundry melts about 50,000 pounds of metal and produces about 30,000 pounds of good castings. Accurate and detailed daily report sheets are kept and from these it appears that the loss, when averaged over long periods of time, runs about 10 per cent. Under normal conditions 300 men are employed. At the present time all melting is done in coke-fired furnaces. One of the main melting rooms is shown in Fig. 11. The melting installation includes 175 crucible furnaces and one Hawley-Schwarz melting furnace. Consideration for the health and comfort of the workmen is evidenced by the fresh air pipes shown in the background, Fig. 11.

In Fig. 10 is shown the furnaces used for melting scrap. The air hoist recently has been installed for handling the crucibles. With this lifting device the pouring of the ingot molds is greatly facilitated.

Fig. 9 shows the Hawley-Schwarz scrap melting furnace, together with the revolving ingot molds into which the metal is cast. Under each of the batteries of molds are shown the ingots which have just been discharged. Each ingot bears a mark indicating the class of metal from which it was cast, thereby preventing possible confusion in the stock issuing or weighing rooms. The only scrap used is that recovered from old cash registers and gates, the metal recovered by the separating mill, and the machine shop turnings and waste. The new metal required is purchased in the form of ingots and pigs of copper, tin, zinc, etc. It has not been the policy to buy guaranteed ingots other than those of pure metal, or to buy scrap brass in the open market. It has been possible to use a reasonably constant quantity of scrap parts, which, having been previously made in this same foundry, are of known composition.

The foundryman accustomed to making brass or bronze in which strength is the determining factor, would be impressed by the exactness of the color standard which is maintained. Three bronze mixtures of three different shades are cast daily. Not even the slightest variation in color is allowed. The reason for this arises from the fact that the plant is called upon to furnish repair parts for machines manufactured years ago. All of the bronze parts of a cash register are on the outside, and repairs when in place are brought directly alongside of other bronze parts with which they must be in perfect harmony. Again, a business house or store having purchased a partial equipment of cash registers, and wishing to add to it from year to year, naturally insists on having all of the machines of the same color. From this arises the necessity not only of maintaining the standard from day to day, but from year to year. The foregoing facts have led the foreman of this foundry into some interesting experiments. Those who have worked with alloys most will best appreciate the difficulties which he has encountered. Since the time when the formulas for these bronzes were established, metal prices have not alone fluctuated, but the relation between the costs of the different metals has apparently changed permanently. As a result, if new color standards could be established, it would be possible today to make a much cheaper bronze which would meet the other physical requirements quite as well as that now being used. The old formulas specify an amount of tin which at present prices is disturbing. To avoid this, experiments

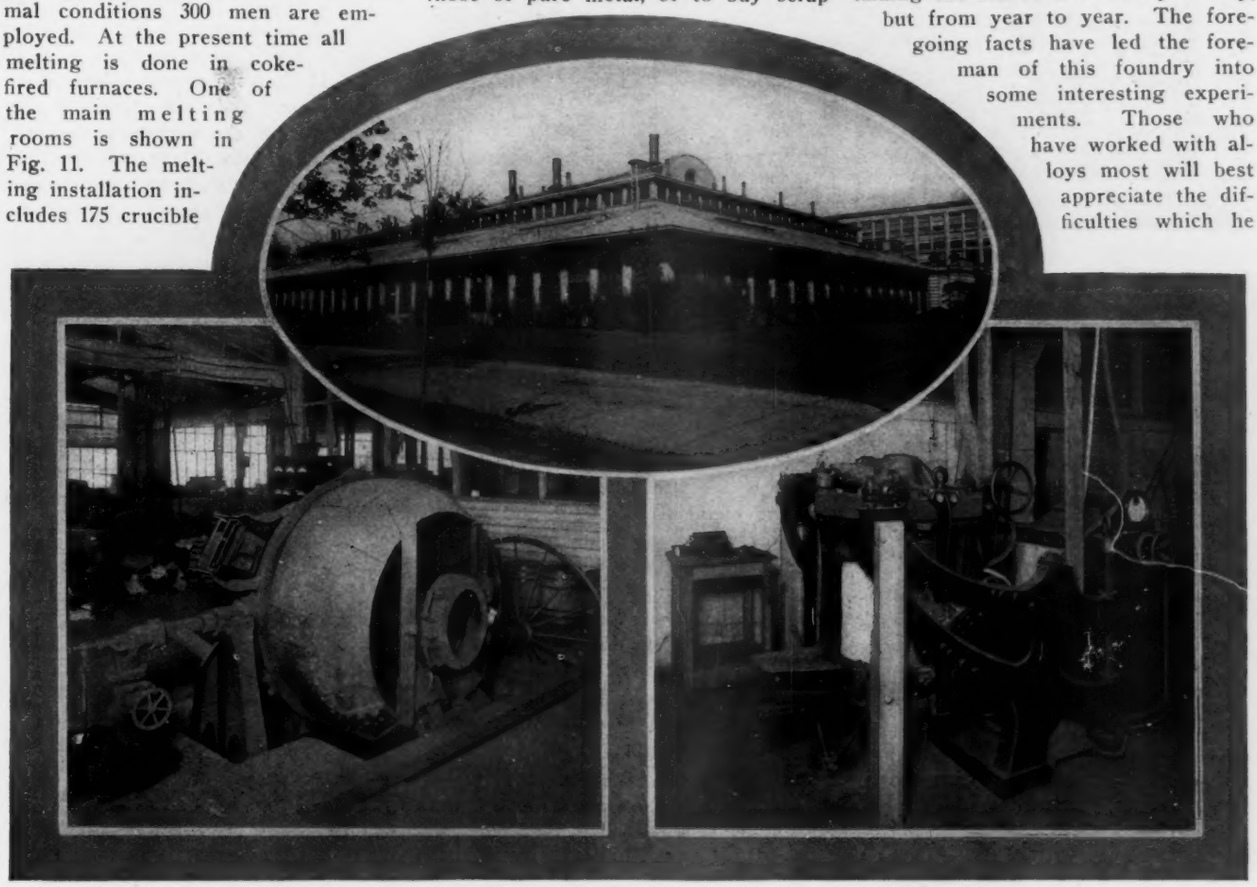


FIG. 13—ONE OF THE TWO BRASS FOUNDRIES. THE WELL-KEPT GROUNDS ARE CHARACTERISTIC OF THE ENTIRE NATIONAL CASH REGISTER PLANT

FIG. 14—THE HERING-CLAMER ELECTRIC FURNACE UNDER CONSTRUCTION

FIG. 15—THE HELBERGER ELECTRIC FURNACE WHICH HAS BEEN OPERATED SUCCESSFULLY

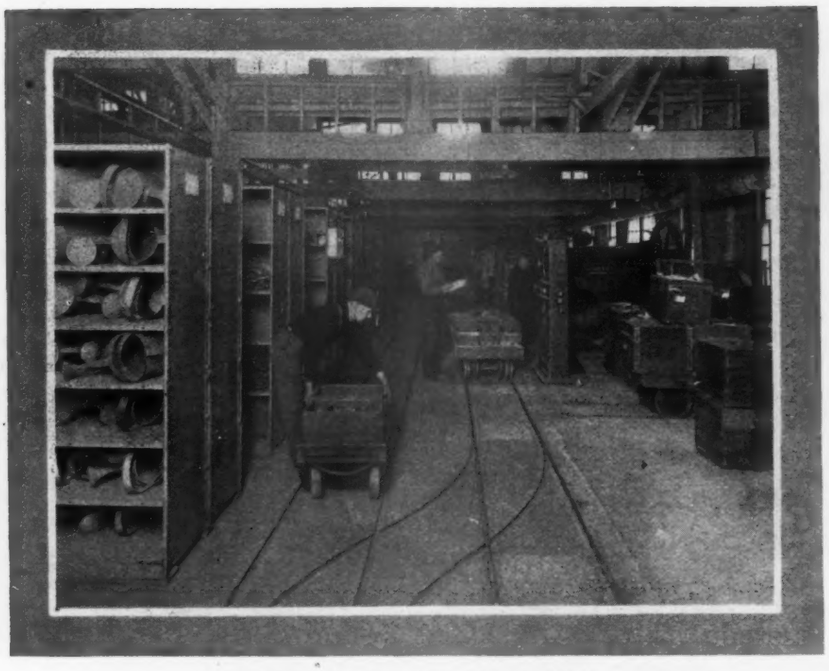


FIG. 16—THE METAL STOCK ROOM

are being made in the substitution of other metals for a portion of the tin. Those who have had experience with alloys know that this is not like mixing paints. In fact, while the addition of a small amount of a certain element may darken the color of the composition, the addition of a still larger amount may produce a reverse result. Moreover, machining qualities demand consideration.

Figs. 14 and 15 show two electric furnaces which are being installed. The furnace, Fig. 14, now under construction, is of the Hering-Clamer type. Fig. 15 is a view of a Helberger electric resistance furnace imported from Germany. A successful test of this has been made within the past few weeks. Data of this trial will soon be available from which it is hoped that not alone the practicability of the furnace will be established, but in addition that it may be shown that the current consumption and cost of operation is sufficiently low to warrant the introduction of similar equipment elsewhere.

Little mention has been made in this article of the numerous alloys cast in this foundry in addition to the three ornamental bronzes. Fig. 12 shows one corner of the white metal room in which a recording pyrometer is shown in use.

A thorough and complete routing system has been developed in this plant so that the metal starting from the weighing room travels through the successive steps from the melting furnaces to the molds, from the molds to the cleaning department, and thence to the inspection and shipping room, without doubling back on its route. A view of the metal weighing room from which the stock for each melt is issued is shown in Fig. 2. On the car in the background are several of the steel-bound, galvanized iron boxes which are used for transporting the metal from this room to the furnaces. The materials for one furnace charge are placed in each box. In this connection a new system is being developed to avoid any possible error in weighing the charges or in charging the furnace. Fig. 17 shows a blank used for keeping the record. These blanks are filled out in duplicate by the weigher, O. K.'d by the checker and the original placed in the box with the charge while the duplicate is retained and sent to the office. This puts the proper material before the furnace man in such a way that an error cannot be made in charging unless metal is left laying on the floor beside the furnace. In addition, the scales shown in Fig. 2 have the pan beam so graduated that it is only necessary to set the counterpoise on this beam at the same graduation as the counterpoise on the platform beam is set, in order to weigh out the metal charge on the platform and the proper amount of "mix" on the pan. This is, of course, possible only in the case of those metals most commonly cast. It will be noted that this blank provides a complete office record both of the materials used and of the operation of each individual furnace.

Fig. 16 shows a general view of the stock room and the trackage arrangement for the conveyance of materials about the plant. It will be noted that all shelving is of steel construction, so placed as to conserve floor space and to be of easy access. The galvanized iron boxes used for moving materials about the plant are light, easily handled and practically indestructible. The neatness and convenience of these is in striking contrast to the rough board boxes so generally used for this purpose, and their more general application to similar uses might be considered with profit by plant managers elsewhere.

The casting cleaning department, where the brushes, grinders and saws are located, is shown in Fig. 5. This view, perhaps better than any other, shows how well the entire plant is lighted. Even on the darkest day very little use is made of artificial illumination. In the machine shops as well as in the foundries, the ceilings are of good height, giving plenty of head room and air space.

A true idea of the real character of

MELTER'S STOCK RECORD **Date**

Copper	Mix	Back-stock	Brass	Alumi-num	Nickel	Zinc	Tin	Lead	Antimony	Total Wt.

Furnace — Moulder — Melter — Weigher — Remarks

Heats	1	2	3	4	5	6	7	8	9	10	11	12
Metal												
Crucible												

1899—10-10-10-R

FIG. 17—MELTER'S STOCK RECORD BLANK

this foundry plant would not be obtained without some attention to the exterior views as shown in Fig. 13. Here is seen a foundry, the outside of which is quite as attractive as the yard about the average, well-kept home. The effect of such surroundings is not wholly lost on the workmen. It is probably not too much to suppose that some measure of the neatness and cleanliness which charterizes the interior is the direct result of the beautification and landscape gardening which greets the eyes of the employe when he comes to his work in the morning. And the absence of the usual foundry storage yard, which at best is always far from attractive, is no less striking. Welfare and beautification work, to most plant managers, may seem far remote from efficiency and low cost of production. Unintelligent welfare work, certainly is. It is nevertheless interesting to note that the striking improvements in the methods described, all have occurred within a period of four years, during which period welfare work at the National Cash Register Co. has been carried on much more actively than at any other time during its history. This characteristic of the management does not evidence itself as a coddling of the employes. It is simply a healthy interest in the workmen. Coupled with it is the policy of placing a premium upon any practical suggestion for betterment in the method of doing things, without any regard to whether the suggestion comes from a skilled laborer or from an official. In this way the foremen and even officers are developed from the ranks. In fact, the present management of the foundry is in the hands of men who gained their positions by seeing better ways of doing things, and who have not yet forgotten why advancement came to them.

Certainly here a broad interest in the welfare and well being of employes has developed efficiency and progressiveness. And they are of the kind that makes itself manifest in the month to month balance sheet.

The Non-Ferrous Alloy Test Problem*

By V Skillman †

THE modern jobbing brass foundry which serves the particular class of trade, is constantly called upon to furnish data regarding the physical properties of its alloys. Such information is usually wanted, either in the form of data obtained by the foundrymen, or in the shape of test pieces from which data can be obtained by the customer himself.

In the former case it will be logical to assume, provided the foundry was producing the common and well-known non-ferrous alloys, that much of the needed data could be gathered from the rapidly increasing volume of literature, dealing with such alloys. Anyone, however, who has had occasion to search the available literature for fairly definite information regarding the physical properties of the common brass foundry alloys, has, undoubtedly, been impressed by two things. First, the meagerness of the data to be had and, second, the worthlessness of much of the information found. The latter is due to neglect, either intentional or otherwise, to adequately describe the specimens from which the facts were obtained.

Tests Demanded

How are we to make test specimens which will best give the physical properties of an alloy? The properties desired may be only the tensile strength and elongation, or they may include the compressibility, electrical conductivity, heat conductivity, hardness, specific gravity, or a number of other properties, which would increase the difficulties of producing suitable test specimens. If we confine ourselves for the present to specimens, for tensile testing, the complicated nature of the subject can probably be sufficiently well known.

As is well known, there are, broadly speaking, two methods of producing test specimens of an alloy. One is to cast the piece in a sand mold in the manner in which a casting of the metal would probably be made, and the other is to pour the alloy into a mold having a higher heat conductivity and made probably of metal. Which one of these methods will produce a test piece from which we can best determine the physical properties of the alloy? It must be understood that we are not looking for the method which will produce a test piece from which the highest results may be obtained, but we do want a test specimen from which sufficiently accurate data can be obtained for us to judge if the heat of metal it represents, is above or below par.

Each method of procedure has its advantages and disadvantages. In discussing the subject the first argument usually advanced is that the sand cast test piece is preferable to the chilled one, as it more nearly represents the material when in the form of castings. The more closely we study the subject the more some are inclined to wonder if this is so.

Take as an example a casting in the form of a four-cylinder automobile crank case of good design poured from the usual mixture of 92 aluminum and 8 copper. If standard Society of Automobile Engineers' test bars for aluminum alloys are attached to the casting and the metal is poured at 1,300 to 1,350 degrees Fahr., which would be a good temperature for such work, we should find, on breaking the bars, that they had strengths of from 18,000 to 20,000 pounds per square inch. If the crank case be then dissected and the strengths of various portions determined, we would find that the side walls, 3/16 or ¼ inch in thickness, had strengths in various places ranging from about 12,000 to perhaps 22,000 pounds per square inch. The former figure would be obtained close to a boss or heavy lug which held considerable heat. The latter figure would be obtained on material under or close to a chill. The greater part of the wall would have strengths between 15,000 and 17,000 pounds per square inch. A piece from a bracket or a brace which, about ½ inch thick, would break under a load of 12,000 to 13,000 pounds per square inch, while other sections of about the same thickness, but so located that they were more slowly cooled, would only stand a strain of 7,000 to 10,000 pounds per square inch.

Which Test is Best?

When such figures are arrived at through experience one cannot continue long before wondering if the sand-cast test bar comes very much closer to representing the material in the casting than would a chill cast bar. The same sort of variations would have been encountered if the casting had been made of brass or

*Presented at the Chicago meeting of the American Institute of Metals.

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bronze instead of aluminum and a different form of test coupon used.

Designing engineers should realize that the strength of a casting often depends as much on the design as upon the metal employed. Many engineers have an idea that any given alloy, if properly compounded and cast, has a definite strength. To this figure, whatever it may be, is added a factor of safety, and the result is a definite value to be used in calculating the necessary thickness of metal in any casting made from the particular alloy. More consideration should be given to the fact, that doubling the thickness of a piece of cast material seldom doubles the strength.

Table I.

Analysis: Copper, 89.15; tin, 9.97; lead, 0.12; and phosphorus, 0.41 per cent.

Bar pattern.	Per cent elongation in 2 inches.	Tensile strength per square inch.
C	8	50500
A	5	32300
A	6	34200
F	3	27000
F	8	31500
H	4	24000
H	2	18500
I	2.5	22500

Table II.

Analysis: Copper, 88.53; tin, 11.08; lead, 0.13 and phosphorus, 0.18 per cent.

Bar pattern.	Per cent elongation in 2 inches.	Tensile strength per square inch.
C	10	51500
A	7	35000
A	7	37800
A	9	36700
F	12	34500
F	13	34500
B	13	28500
B	11	27500
E	8	27500

Table III.

Analysis: Copper, 82.78; tin, 9.37; lead, 7.20; zinc, 0.47 and phosphorus, 0.20 per cent.

Bar pattern.	Per cent elongation in 2 inches.	Tensile strength per square inch.
A	11	33200
A	9	31000
A	7	28000
D	4	17750
B	10	22750
B	5	15500

Table IV.

Analysis: Copper, 79.07; tin, 11.47; lead, 7.16; zinc, 0.53; antimony, 0.05 and phosphorus, 0.92 per cent.

Bar pattern.	Per cent elongation in 2 inches.	Tensile strength per square inch.
C	1	46500
A	1	26200
A	1	27200
G	1	24500
H	1	21750
H	1	20950

Since the strength of a casting depends so much upon the designer, we evidently cannot hope for any standard form of test coupon to do more than indicate the quality of the metal used, and it seems at times that a chilled sample would answer the purpose as well or better than a sand cast bar.

Referring again to the aluminum crank case with attached test bars, if such a casting were poured at entirely too high a temperature, the strength of the attached test bars would be materially lessened and the fact that the casting had been poured too hot, would be indicated. It is a question if the chilled specimen of the alloy would do the same.

On account of the rapid chilling which would take place it seems likely that the effects due to differences in pouring temperature would be minimized and likewise the chill cast test piece would be incapable of showing other possible variations in foundry practice. This appears to be one of the greatest legitimate objections to the use of the chilled coupon.

Bad Reputation of Chilled Bar

There is another objection to its use which is its bad reputation. This is really unfortunate for the chill cast test piece as its bad repute is really a result of its good qualities. Chilled test bars do give high results, and for that reason they have been and even now are being palmed off by unscrupulous founders onto unsuspecting purchasers, who are led to believe that such bars represent the material which they are or would be furnished in the form of castings. If they are not encouraged in such a belief, they at least are not prevented from believing so if they wish. In consequence, chilled test bars are said to give fictitious results when it should be said that they have at times been used to deceive. The bars themselves are not at fault and the objection to them on this ground can be dismissed.

In fact, more peculiar results can be obtained with sand cast test pieces than with those cast in a chill mold. The strength obtained varies widely with the pattern of the test piece. This was shown to be true for manganese bronze and a red brass by Jesse L. Jones in his paper on "Test Bars for Non-Ferrous Alloys," read before the American Institute of Metals a year ago. This great possible variation in the properties, as obtained from different forms of test pieces, of a single heat of metal, together with the fact that we have no standard pattern of test piece to use, is one of the great arguments in favor of adopting the chilled sample for the present at least.

Such a procedure would give us a test piece not influenced by variables such as pattern, method of gating, method of molding; quality, temper and fineness of sand, method of pouring, method of cooling, etc. As long as we have no standard pattern for sand cast samples and the effects of these variables are no better understood than they are at the present time, we can only expect, as has been previously pointed out, to obtain from the test samples an indication of the quality of metal poured. Will not the chilled sample give this as well as any other form?

At the present time the writer is using both chill and sand cast test pieces. The results from the former are depended upon to give comparable figures to be used in judging different alloys and in determining the physical properties of a given alloy. If a single pattern of sand cast bar were used for this purpose very good results might be obtained with one class of alloys, while poor results might be had with another.

Table V.

Analysis: Copper, 87.55; tin, 10.10 and zinc, 2.27 per cent.

Bar pattern.	Per cent elongation in 2 inches.	Tensile strength per square inch.
A	38	51500
A	40	51800
F	21	38000
F	33	42000
H	29	39000
H	24	38500
I	40	46500

Table VI.

Analysis: Copper, 86.78; tin, 8.81; lead, 2.12 and zinc, 2.42 per cent.

Bar pattern.	Per cent elongation in 2 inches.	Tensile strength per square inch.
C	17	48000
A	41	46600
A	29	44600
F	22	35000
F	28	37500
H	27	36000
I	32	41000
I	36	42000

Table VII.

Analysis: Copper, 83.68; tin, 5.06; lead, 5.03; zinc, 5.47 and antimony, 0.35 per cent.

Bar pattern.	Per cent elongation in 2 inches.	Tensile strength per square inch.
C	15	40000
A	16	32350
A	15	31600
A	20	35500
D	8	21000
B	26	32500
B	27	33000

The pattern of a sand-cast coupon, which gives dependable tests with manganese bronze, gives, with the standard No. 12 aluminum alloy, a strength of about 15,000 pounds per square inch, while the standard S. A. E. bar would give 20,000. At the same time, the S. A. E. bar, when used for manganese bronze, gives varying results on account of the difficulty of proper feeding, etc. Sand cast test bars are, however, also used by the writer and whatever information possible is obtained from them. But at best, it is variable and uncer-

tain. In spite of the publication of Mr. Jones' and other similar papers, it does not seem to be very well understood that in giving the strength of a sand cast alloy, it is also necessary to describe the form of the cast test piece, in order that the information may be complete.

Results of Experiments

Many are surprised at the varying results which may be obtained from one heat of metal when different patterns of test coupons are used. Perhaps the experiment has not been tried by many and some figures may be of interest. This data has all been obtained while carrying on other lines of investigation, and each table of results were obtained from a regularly melted foundry heat of 100 pounds or more of metal. The melting and molding conditions were equivalent, we believe, to what is considered good brass foundry practice. The results are thus practical. The analyses were made on drillings taken from the chilled test bars. The patterns used may be described briefly as follows:

Pattern *A*.—This is a cast-to-size bar such as is recommended for aluminum alloys by the S. A. E. It is ½ inch in diameter in the test section and is broken without machining with V-shaped grips.

Pattern *B*.—This is the Clamer modification of the Reeves bar used for manganese bronze. It is a block, 4½ inches long, 3 inches wide and 4 inches deep, carrying three test pieces 1 inch square and 4½ inches long. It is Jones' Pattern 28292-A.

Pattern *C*.—This is an open iron mold which gives a chilled bar about 2 feet long and 1 inch square.

Pattern *D*.—This pattern is barrel-shaped, 4½ inches long, 1⅛ inches in diameter at the ends and 1¼ inches in the center. A 3-inch riser extends nearly its entire length.

Pattern *E*.—This is similar to *D* in shape, but is 12 inches long, 1⅛ inches in diameter at the ends and 1½ inches in the center. It is cast with a riser the same as *D*.

Pattern *F*.—This pattern is 4½ inches long by ⅞ inch in diameter. It is gated at one end with a riser attached to the other; it is cast horizontal.

Pattern *G*.—The same as *F*, but 7 inches long by ¾ inch in diameter.

Pattern *H*.—The same as *F*, but 8 inches long by 1 inch in diameter.

Pattern *I*.—This pattern is 4½ inches long and the shape of a test bar with considerable allowance for finish. It is ⅝ inch in diameter in the test section and ⅞ inch at the ends.

All test pieces, with the exception of those from pattern *A* were machined to the standard test bar size, 2 inches long in the test section and 0.505 inch in diameter, and pulled with threaded grips. The results of these tests are given in Tables I to VII.

No attempt will be made to draw any conclusions from the data contained in these tables, as they are given simply to emphasize the pressing need for some settlement of the non-ferrous alloy test specimen question. The problem is entirely too large and would prove too costly for any commercial concern to undertake its solution. We may be considered exceptionally fortunate, therefore, in having the able assistance of the bureau of standards in the work. The subject is well worth the consideration of all, from both technical and commercial viewpoints.

PROBLEMS OF THE BRASS FOUNDER

What To Do and How To Do It

Hydraulic Bronze Mixture

We have been using hydraulic bronze for making hydraulic press castings, but it has not given very satisfactory service. We would be pleased to have some information regarding the tensile strength and elastic limit of an aluminum bronze alloy. Also, can you give us the composition of a dense aluminum bronze alloy which will resist hydraulic pressure?

The tensile strength of aluminum bronze is liable to variation within wide limits and may range from 40,000 pounds per square inch to more than 80,000 pounds, for a 10 per cent bronze. This variation is due to the manner in which the alloy is handled in melting and the temperature at which it is poured into the mold. The elastic limit of aluminum bronze apparently is low as compared with steel of the same ultimate stress, but as shown by Carpenter and Edwards in the eighth report to the Alloys Research Committee of the Institution of Mechanical Engineers, London, Eng., this inferiority is more apparent than real. It is claimed that a 10 per cent aluminum bronze compares favorably in physical properties with a Swedish Bessemer steel containing 0.35 per cent carbon.

A dense aluminum alloy can be made as follows: Copper, 85 per cent; 30 per cent manganese copper, 1 per cent; nickel, 4 per cent, and aluminum, 10 per cent. The physical properties of this alloy follow: Tensile strength, 69,500 pounds per square inch; elastic limit, 25,500 pounds per square inch; elongation, 17 per cent; reduction of area, 16.8 per cent, and Brinnel hardness, 93.

Considerable difficulty will be experienced in successfully casting hydraulic cylinders with aluminum bronze unless the metal is rapidly chilled. For sand castings, proceed as follows: Melt the bronze in a bottom-pour crucible, mold the cylinder vertically and pour the casting from the bottom placing a heavy feeder on top of the mold. Surround the mouth of the sprue with a ring of waste soaked in heavy oil and keep the lip of the pot as low as possible while pouring. The metal should be cast with sufficient speed to keep the sprue head full and the metal should be hot. If sound aluminum bronze castings can be obtained, it will be found superior to any bronze or so-called hydraulic metal. When aluminum bronze castings are good they are exceedingly desirable.

German Silver Difficulties

We are experiencing considerable difficulty in getting clean German silver castings. These consist of large, flat doors, 2 feet 10 inches long, varying in width from 10 to 17 inches and from 1 to 1¼ inches in thickness. The weight of the doors varies from 165 to 205 pounds. German silver clippings are used in the mixture, as well as some aluminum. The surface of the castings is satisfactory, but when machined, the metal is honeycombed. We have tried melting in both oil-fired and forced-draft furnaces with equally unsatisfactory results. The castings must be clean on both the cope and drag sides and in pouring we have tried both hot and cold metal.

German silver containing aluminum is difficult to cast and probably in this instance the aluminum is the cause of your difficulty, as it produces dross which develops when the casting is machined and frequently is mistaken

for blow-holes. We would suggest that you try the following method: Place the crucible in a furnace capable of attaining a high temperature and place a layer of powdered charcoal in the bottom of the pot. On top of the crucible set a ring made by cutting off the bottom from an old crucible, charge the scrap and 2 per cent of 30 per cent manganese-copper. When the charge begins to melt, add a mixture of broken glass and soda ash or ordinary washing soda if soda ash is not available. The object of this flux is to form a cover for the molten metal, as charcoal alone is not satisfactory. As the original charge of scrap melts, an additional charge should be placed in the crucible ring and when this becomes hot, it should be pushed down into the metal underneath. When the crucible is full, add about 2 per cent of zinc to replace this amount lost by oxidation and the metal then should be raised rapidly to the proper pouring temperature, removed from the furnace and cast. If it is necessary to use aluminum to insure the proper filling of the molds, use as small an amount of this as possible to accomplish the desired result.

Mill Brasses

Kindly furnish us with practical formulas for hot and cold mill brasses.

For cold mill brasses, the following alloy is recommended: Copper, 83 per cent; tin, 12 per cent, and lead, 5 per cent. For hot mill brasses, the following will give excellent results: Copper, 88 per cent; tin, 10 per cent, and phosphor tin, 2 per cent.

Nickel Alloys

Can you give us some information regarding nickel alloys suitable for the working parts of valve interiors, especially valves subject to both high and low pressure steam at temperatures from 500 to 650 degrees Fahr.? A nickel bronze would answer the purpose.

A nickel bronze that probably will answer your purpose consists of copper, 86 pounds; tin, 10 pounds; nickel, 3 pounds, and phosphor tin, 1 pound. The value of small additions of nickel to bronze is questioned, although some extravagant claims have been made relative to the increased physical properties of bronze treated with nickel. As a rule, it is difficult to discover any particular improvement in the properties of metal so treated, and while there may be some slight gain in ultimate strength, this usually is at the expense of elongation. Nickel has no particular deoxidizing or strengthening value when added to bronze, and there is no scientific reason why the so-called nickel bronzes should be better than bronzes made without nickel, such as, for example, an alloy containing copper, 88 per cent; tin, 10 per cent, and zinc, 2 per cent. To derive the benefits of the non-corrosive properties of nickel, a relatively large amount of this metal is required in the alloy. We suggest a trial of one or both of the two following mixtures:

Copper, 50 per cent; nickel, 48 per cent, and manganese-copper, 2 per cent.

Copper, 65 per cent; nickel, 33 per cent, and aluminum, 2 per cent.

Difficulties from Use of Aluminum Scrap

We are engaged in the manufacture of aluminum carpet sweeper castings which develop dirt underneath the surface when they are machined. This is particularly true where the gate enters the casting. We have been using salt in the crucible to clean the metal, but without success. How can shrinkage be eliminated? We also would like to have a few good aluminum mixtures that will take a high polish.

Use new aluminum in the form of ingots for your castings, as the scrap aluminum causes the difficulties which develop after machining these castings. The best alloy for your purpose is No. 12. Melt 25 pounds of copper, and just before it is entirely liquid begin the addition of 25 pounds of aluminum in small pieces. By adding the aluminum the temperature of the alloy will be increased and any pieces of copper not molten at the time the aluminum is added will be melted. After adding the aluminum the alloy should be stirred thoroughly and cast into ingots. This forms a hardening for aluminum and is used in the proportion of 16 pounds to 84 pounds of aluminum. The hardening is placed in the crucible first, after which about three times its weight of pure aluminum is added. This is melted and after the hardening is thoroughly incorporated, the balance of the aluminum is added as rapidly as it will melt. To obtain the proper pouring temperature use a pyrometer and do not allow the aluminum to become heated in excess of 1,300 degrees Fahr. Use zinc chloride for fluxing.

Melting Bronze in a Cupola

I am casting a bronze drum, 5 feet in diameter and 12 feet long, the thickness of the metal being about 1¼ inches. There is an internal flange at each end and the total weight of the drum is about 16,000 pounds. The outer diameter, as well as both ends, are machined and polished. The drum is cast on end, the core being swept up in loam. With a mixture of 88 parts copper, 10 parts tin and 2 parts zinc, melted in a cupola, the casting contains small holes under the skin. What steps shall I take to secure a perfect casting?

It is a difficult proposition to make a sound, clean casting of any size from an 88--10-2 mixture, when melted in a cupola. This mixture is much addicted to the production of porous castings, even when melted in crucibles unless the greatest care is exercised to protect the metal from the furnace gases. Castings of the size mentioned should be poured from metal that has been melted in an air furnace, and if they are frequently required, it would pay to build an air furnace as more or less trouble will be experienced every time they are cast from a cupola. This is due to the contact of metal and fuel, to the absorption of sulphur from the coke together with oxygen and nitrogen from the blast. It is very difficult to remove these elements from molten bronze, and it is a question whether any deoxidizer will do it. We suggest the use of phosphorus and manganese in the proportion of 4 ounces of 30 per cent manganese-copper, and 2 ounces of 15 per cent phosphor-copper per hundred pounds of metal melted. These deoxidizers should be warmed, placed in the bottom of the ladle and the metal tapped directly on them. The agitation resulting from the stream of metal should produce intimate mixture and when the ladle is filled the metal should be covered with granulated charcoal.

Mixing and Melting Magnalium

We have an inquiry for magnalium castings and would like to know how to mix and melt this alloy.

Magnalium is an alloy of aluminum and magnesium. In connection with either zinc or copper and nickel, the content of magnesium will range from 1 to 10 per cent, according to the degree of hardness required in the casting. The addition of magnesium to aluminum confers no particular physical properties upon the latter, with the exception of that of hardness. It does not deoxidize aluminum and adds to the casting difficulties. We would suggest that the metal be melted carefully to avoid overheating. It is not necessary to get the metal red hot. Use chloride of zinc as a flux and cast the metal below a red heat, as the presence of magnesium will make the aluminum more sensitive to oxidation than ordinarily. For ordinary castings made in sand molds, few aluminum alloys equal No. 12, which contains aluminum, 92 per cent, and copper, 8 per cent.

Relative Efficiencies of Sand Blast Nozzles

An Interesting Comparison of Various Types, Showing How They Are Designed and Constructed

By B H Reddy

CLEANING castings with sand blast apparatus can be made to show considerable economy over the ordinary method of chipping, scraping and brushing by hand and at the same time the operation leaves the castings in such a condition that the expense of machining is reduced materially. All burned sand and scale are thoroughly removed from the surface of the castings, thus greatly lessening the wear on the edges of the cutting tools. This results in longer cuts, less time lost in grinding and setting tools and reduces the amount of tool steel used. But it is remarked frequently that although the sand blast does nice work, it is expensive. This, however, depends entirely on the manner in which the sand blasting is done. If a greater air pressure is used than is necessary to perform the work, a loss results from the excessive power required to compress the air and there also is an unnecessary amount of sand lost through breakage of particles. Improperly designed nozzles frequently increase the expense of sand-blasting unnecessarily.

Due to the abrasive action of the medium used, the nozzle tips wear out rapidly. In an effort to overcome this, many different materials and forms of construction have been tried. Tips have been made from rubber, tempered steel and chilled iron. Nevertheless, the abrasive action of the sand cannot be avoided and although the wear has been minimized in some cases, it still exists. The rate of wear varies greatly with the type of nozzle employed.

Nozzle of Injector Type

Fig. 1 shows a section of a nozzle commonly known as the suction or injector type. The tips *A* and *B* are made of chilled iron. The air, under pressure, escapes from tip *B* through tip *A* and forms a partial vacuum in the sand hose. This sucks air and sand through the hose. The inside of tip *A* wears out rapidly while the outside of tip *B* also is cut away somewhat more slowly. When using this form of nozzle it is necessary to arrange the feed at the entrance of the sand hose in such a manner that it will not become clogged. Fig 2 shows a simple method by which this can be accomplished. The sand is kept in a box which is provided with a sloping floor leading to a chute through which the sand flows onto a platform. The end of the hose is fastened to the platform in such a manner that the sand is readily sucked in. The nozzle, however, is wasteful of both sand and air. By cutting off the sand supply, the nozzle may be used for removing loose sand, blacking, dust, etc., from otherwise inaccessible places in molds.

Fig. 3 illustrates a form of nozzle designed to reduce the wear at the tip. The air escapes from a narrow annular opening surrounding the end of the sand tube and only a portion of it does useful work in carrying particles of sand. Energy is imparted to the sand only at great loss of efficiency, but the wear is reduced to such an extent that one nozzle may be used for a number of months. A nozzle of this type usually is employed in such a manner that the work lies underneath it or else it is suspended by the sand hose from an elevated bin so that the sand feeds by gravity. As there is very little suction through the sand hose, the nozzle cannot be directed upward at more than a slight angle. It is also said that it will not work in deep pockets. Nozzles of this type usually are made in such sizes that they use from 250 to 300 cubic feet of air per minute.

Fig. 4 illustrates an economical nozzle which uses about 75 feet of air per minute. In this nozzle no energy is expended in bringing up the sand; neither can any of the air escape without imparting its energy to the sand. But, on the other hand, the nozzle can be used only with a pressure type machine in which the sand is contained in a closed tank. The tip is subjected to wear, but is so designed that it may be replaced readily and the cost of maintaining the nozzle is low. The various parts can be made from castings and assembled without machine work. The tips usually are made of white iron. As the tips increase in inside diameter, the consumption of air in-

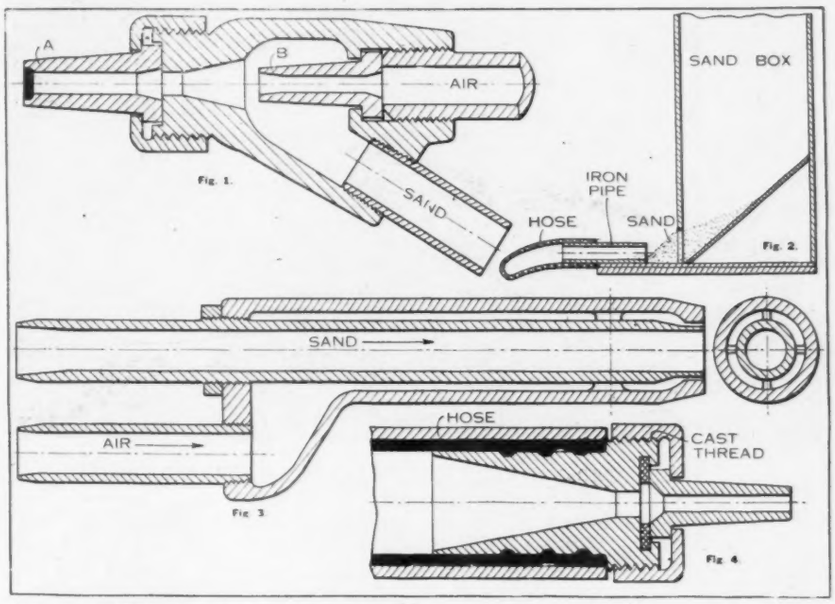


FIG. 1—INJECTOR TYPE SAND BLAST NOZZLE

FIG. 2—ARRANGEMENT OF SAND BOX AND SUCTION HOSE ENTRANCE

FIG. 3—LONG WEARING TYPE SUCTION NOZZLE

FIG. 4—CAST IRON NOZZLE FOR PRESSURE MACHINES

creases. The outside of the tips may be tapered in such a manner that when the inside has been cut out to a predetermined size it will show on the outside. Any workman can readily interpret this phenomenon as a signal to change nozzles.

Complaints frequently are heard regarding the wearing qualities of sand hose, but this is often due to the fact that proper materials are not used in manufacturing the hose. It should be borne in mind that the quality and not the thickness of the inner lining of the hose determines its resistance to wear. A lining which will stretch out almost like a good rubber band when a small piece of it is pulled out between the forefinger and thumb nail, is one which will give good service.

CUPOLA EQUIPPED FOR OPERATION BY THE PNEUMATIC PROCESS

Pneumatic Cupola Process

The pneumatic process of cupola operation, while extensively employed abroad, has not been introduced widely in American foundries. In the accompanying illustration, however, is shown a cupola equipped with four wind boxes to direct the blast into and over the bath of molten iron. The wind box at *A* directs the blast into the bath of molten metal in the bottom of the cupola, while through the wind box, *B*, the blast is directed upon the surface of the metal. Cold air is employed. It will be noted that the receiver is so arranged that a bath of metal, 3 to 4 inches deep, constantly is retained in the cupola. It is claimed that by employing this process some of the carbon, manganese and silicon in the iron are burned, increasing the temperature of the iron, which absorbs carbon from the coke, and in gray castings changes any excess graphitic carbon in the iron to the so-called graphitic-tempered carbon It is the latter state of the carbon that closes the grain and increases the tensile strength of the iron.

By the employment of this pneumatic process, lower grades of iron can be used in the mixture and an increased amount of iron and steel scrap also can be used. While the grain of the cast iron is close, its softness is not correspondingly reduced and castings made from such iron can readily be machined. It is claimed that the tensile strength is increased approximately 25 per cent. The fracture of iron melted in this way appears unmachinable, yet notwithstanding this fact the iron is comparatively soft. The blast pressure employed varies from 3½ to 5 pounds. It will be noted that the receiver is covered, the circular top being held in place by rods. When the receiver is closed, the cover is luted onto the side. This process is being introduced by the Pneumatic Cupola Co., Ashland, Ky.

A new alloy for casting type has been invented by George R. Wagner, New York City, which consists of lead, 82 per cent; antimony, 13 per cent and tin, 5 per cent.

Silica Facing Mixture

Question:—Kindly furnish us with a mixture for a silica facing sand, to be used on green sand molds for steel castings. This facing is to have a thickness of about 1 inch around the entire pattern.

Answer:—Silica sand is used as a facing for sand molds in which steel is cast, on account of its refractoriness, as it will not fuse when in contact with the molten steel, which is cast at a much higher temperature than iron. As a molding material, however, silica sand lacks cohesive qualities and for this reason some plastic material must be mixed with it, clay usually being employed for this purpose. The difficulty experienced in making a facing is in the addition of a proper amount of clay. Too high a percentage of this bonding material, while giving a strong facing, makes the mixture too close. As a result, the gases cannot escape and the resulting castings will have scabs and other defects. If the amount of clay is too small, the mold is liable to be too fragile to withstand the pressure of the metal. Bearing these facts in mind, a satisfactory facing can be made after a few experiments have been conducted. The facing should be about as tough as ordinary molding sand and a few trials with mixtures of varying proportions of silica sand and clay will satisfactorily solve this problem. For dry sand facings, molasses generally is added to the sand and clay for the same reason that it is occasionally employed in ordinary molding sand, namely for its hardening effect on the surface of the mold. Every effort should be made to obtain silica sand of great purity. Occasionally a small amount of flour is added to the mixture. A typical silica facing mixture follows: Silica sand, one wheelbarrowful; flour, one shovelful, and fire clay, one to two shovelfuls. The ingredients should be mixed thoroughly.

Chemical Changes of Malleable Iron

By Dr. Richard Moldenke

Question:—When malleable iron is melted in a cupola, what chemical and physical changes does it undergo, and what causes these changes?

Answer:—Melting malleable iron, meaning thereby annealed material, produced by the regular malleable iron process, wipes out the change from a hard white iron, with its carbon in the combined form, to the soft, ductile material with the carbon in the temper-carbon or amorphous graphite form produced by the annealing process. The

result is a return to the original hard casting. However, the iron contains lower silicon and manganese due to the oxidizing influence of the remelt in the cupola.

A malleable casting is not a product of direct melting, as drastic heat treatment is interposed, differing from that employed in the production of other forms of iron and steel, and for this reason the product is unique in the art of iron manufacture. By remelting malleable iron the effect of this heat treatment is destroyed. Any iron containing low silicon, remelted malleable scrap, after being tapped from the cupola, will make dead white castings, and if the silicon is not too low, these can again be annealed and will give the black heart fracture.

When melting malleable iron in the cupola, the temper-carbon present is converted into the combined form. About 0.25 per cent of the silicon is burned out and a considerable percentage of the small amount of manganese present also is lost. The resulting metal is not very good, and for this reason malleable scrap should be used sparingly for important casting work. The annealing process is intended for the reduction of the combined carbon in the hard casting, which will approximate, for example, 2.80 per cent to a percentage considerably lower than 0.75 to 0.80 in the finished malleable casting. If this reduction is not accomplished, the metal cannot be considered high grade malleable.

Manganese in Cast Iron

By W. J. Keep.

Question.—Some pig iron representatives now are making the claim that high manganese has a softening effect on gray iron superior to silicon. One claims that an iron containing manganese, 0.91 per cent; silicon, 2.25 per cent; phosphorus, 0.83 per cent, and sulphur, 0.012 per cent is superior to an iron containing manganese, 0.25 per cent; silicon, 3.50 per cent; phosphorus, 0.90 per cent and sulphur, 0.033 per cent. Does the increased manganese content compensate for the reduced percentage of silicon? It has been my experience that manganese, when present to the extent of less than 1 per cent has no appreciable effect upon the mixture. Have there been any recent discoveries that would lead to this change in practice, and we would like to have your advice regarding the safe limit of silicon in light stove plate castings with phosphorus not over 1 per cent; sulphur, 0.08 per cent, and manganese, 0.30 per cent? It is our experience that the shrinkage of a ½-inch test bar must be kept under 0.15 inch, and I look to silicon as the regulator. Our castings average 2.55 per cent silicon and I am of the belief that our iron would be softer and stronger if the silicon were increased to 2.70 to 2.75 per cent.

Answer.—If you will refer to the chapter on manganese in my book on Cast Iron you will find that I prove by examples of Swedish iron that manganese does not turn gray iron white, but that it produces a more uniform grain, and I recommend for light castings a manganese of about 0.50 per cent and never over 1 per cent. In such proportions no evil results will accrue. However, in any case, manganese hardens cast iron without increasing the combined carbon, and, therefore, it is desirable for valve seats, cylinders and wearing parts, but is not desirable for stove plate. The sulphur in the castings you are making is a trifle high, but the use of a pig iron containing 1 per cent manganese would not reduce the sulphur content. We would suggest the use of a small amount of lump ferromanganese in the cupola, or if powdered it could be added to the metal in the ladle. This would result in carrying off a small amount of your sulphur in the slag. However, it is advisable to use coke containing a lower sulphur content.

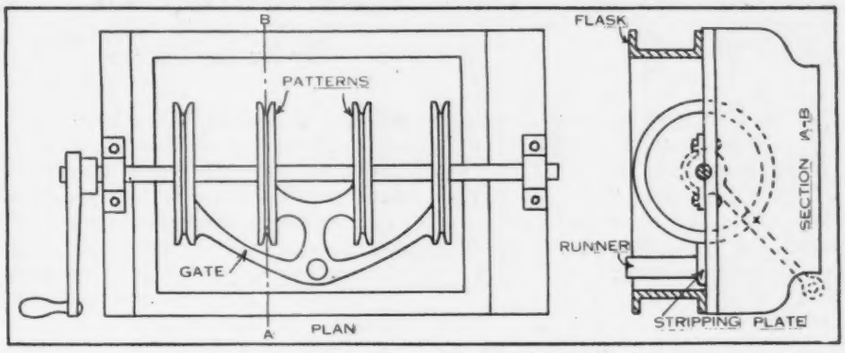
Manganese cannot soften gray iron and can do no good except as previously outlined. The phosphorus content of your mixture is sufficiently high, and under such conditions, silicon is your only softener. The shrinkage of your test bar, however, is too high for an iron containing 2.55 per cent silicon. It should not be above 0.14 inch and 0.1 inch would be better. This would require about 3 per cent silicon in your mixture.

Effective March 1, the Independent Pneumatic Tool Co., Chicago, announced the appointment of the following district managers: R. T. Scott, 1208 Farmers Bank building, Pittsburgh, and F. H. Charbono, 1629 Candler building, Atlanta, Ga.

A Special Sheave Molding Machine

The accompanying illustration shows a sheave molding machine used by the Sandwich Mfg. Co., Sandwich, Ill., in the manufacture of hay baling and other agricultural machinery. The patterns are turned out of cast iron and split. The half patterns thus formed are fixed to a shaft with dovetail keys, or in any other suitable manner, and the shaft is mounted on the platen of the machine so that the half sheaves may rotate freely through a stripping plate, which has been cut to receive them. The shaft is provided with a crank at one end.

The flask is filled with sand when the patterns are in the position shown in the illustration. After ramming is completed, the patterns are stripped by rotating the crank 180 degrees, the half-sheaves then occupying the position under the stripping plate shown by the dotted lines in the sectional drawing. The shaft is fitted with suitable stops so that the crank will not be turned too far in either direction.



PLAN AND SECTION OF SHEAVE MOLDING MACHINE

A permanent multiple gate is fitted to the stripping plate and the machine is mounted at the proper height on a stand. To get the maximum results, the machines should be used in pairs, one making copes and the other drags. The cope and drag are symmetrical, however, so that only one machine is necessary. In this case, the runner stick is only used when molding the copes. For making small sheaves, the machines may be fitted with two shafts, so that there will be from six to eight castings in each flask.

Chilled Iron Difficulties

By W. J. Keep

Question.—I recently had a peculiar experience in making chilled castings. The analysis of the castings poured in green sand, which were white hard throughout their 4-inch thickness, follows: Silicon, 0.83 per cent; sulphur, 0.119 per cent; phosphorus, 0.423 per

cent, and manganese, 1.18 per cent. This mixture consisted of 70 per cent pig iron, 20 per cent car wheel scrap and 10 per cent steel scrap. The pig iron contained silicon, 1.00 per cent; sulphur, 0.43 per cent; phosphorus, 0.44 per cent, and manganese, 2.44 per cent. From another car of pig iron purchased from the same furnace from which we received the iron used in this first chilling mixture, we made up a cupola charge consisting of 65 per cent pig, 25 per cent car wheel scrap and 10 per cent steel scrap. However, the castings were soft gray iron in the place of the white, hard iron, which we desire. The pig iron from this car analyzed as follows: Silicon, 1.10 per cent; sulphur, 0.051 per cent; phosphorus, 0.43 per cent, and manganese, 2.30 per cent. The analysis of the castings follows: Silicon, 0.87 per cent; sulphur, 0.063 per cent; phosphorus, 0.38 per cent, and manganese, 1.74 per cent. A chill test piece made from the latter mixture, 1½ inches thick, 4 inches deep and 6 inches long, showed a chill ranging from ½ to 5/8 inch thick. A test piece made from the first mixture, however, was white throughout its section. I would like to know why the second mixture was soft and why the first mixture was hard.

Answer.—Referring to the analyses, we find that the sulphur in your white iron was 0.119 per cent and in your gray iron, 0.063 per cent. The difference is due to the high sulphur in the iron which ran white. Sulphur has a peculiar affect on iron which is low in silicon. In a car wheel mixture containing 1 per cent silicon it is common practice to obtain the required chill by increasing the sulphur to about 0.10 per cent. Malleable iron in the hard is white and the silicon does not vary considerably from 0.70 per cent, but it must have no chill. This, however, requires sulphur below 0.05 per cent and for this reason it must be melted in an air furnace. In your case the sulphur was taken up from the coke. One of the peculiarities of melting practice is that with similar charges of iron and coke the sulphur one day will be 0.075 per cent and another day it will be 0.045 per cent, although atmospheric conditions may seem to be the same. In melting gray cast iron the higher percentages of silicon and the presence of graphite prevent any large amount of sulphur from being absorbed by the iron and it is customary practice to calculate an increase from the coke of 0.03 per cent.

Facilitating the Handling of "Express" Orders

By Burtner Fleeger

RUSH orders always are more or less of a problem in a foundry, especially in one producing light castings in large quantities, where the number of customers is large and the castings on an individual order small, as compared with the total daily output. The castings being small, are hard to locate when they are permitted to become mixed with the general run of work, and the result is that shipments are not made promptly, frequently only a part of the order being found for the first consignment, much to the incovenience of the customer.

The case of a steel foundry operating a crucible and converter shop is typical, and the system devised to overcome these troubles proved of great advantage in gaining the good will of the customers by giving prompt and complete shipments.

The capacity of the foundry is about 200 tons per month, the class of work being unusually light, averaging less than 6 pounds. The castings range in weight from 1/10 to 200 pounds, and daily shipments of over 2,500 castings, to 30 or 40 different customers, is a regular occurrence.

The Old System

Only foreign labor is employed, very few of the men being able to speak or understand English. The molds formerly were poured off every 30 minutes by a separate pouring gang, the castings having been gathered immediately in wheelbarrows by the floor cleaning men and were dumped in a large space on the cleaning room floor to be sand-blasted by the night crew, who piled them indiscriminately for grinding. The next day the sprues were cut off and the castings finished on grinding wheels; they were then dumped near the annealing oven, as practically all castings were annealed.

As a result, it was quite an undertaking to locate express orders for a few castings, especially if the cast parts became mixed with the general run of work and it was generally necessary for someone to follow the castings through from start to finish, an expensive as well as an inconvenient method of insuring prompt shipments.

The system devised to remedy this is simple, simplicity being essential on account of the foreign labor employed, while the cost of handling the orders was no greater than that of the ordinary run of work.

The New System

When an express order is received, a molding card of a different color than for the regular run of work is filled out. When the molder receives the pattern and molding card, he also is given a square piece of red cardboard for every mold necessary to complete the shipment. As the molds are finished and placed ready for pouring, the molder nails a piece of cardboard to each mold where it will be conspicuous, but will not be destroyed in pouring.

The pouring gang is instructed to pour all marked molds first and the foreman of the floor-cleaning gang impressed on his men the necessity of shaking-out marked molds immediately, placing the castings in a wheelbarrow separate from those poured in unmarked molds.

Prompt Service

Two small spaces are marked off on the cleaning room floor, convenient to the sand blast room, and in one of these spaces nothing but rush castings is permitted to be dumped. The castings in the marked space then are sand-blasted separately from the regular run of work, and afterwards are placed in the other marked space by the sand blast operator. They are next delivered to one grinder, who finishes all rush jobs, and after grinding are placed in a wheelbarrow and delivered directly to the shipping clerk.

The men quickly ***caught-on*** to the system and it required little added effort on the part of the laborers to rush the castings through and to keep them separate from other orders. The rush jobs thus proceed automatically to the shipping clerk in unusually quick time, with no necessity for someone from the office to stand over them from start to finish.

The customer who receives this kind of prompt service from a foundry on his rush orders, usually shows his appreciation by placing the large, profitable orders in the same place, and the foundryman is always well repaid for his efforts along this line.

DIFFICULTIES OF THE PLATER

The Reason Why and the Remedy

Blistering of Nickel Plate

We are nickel-plating small marine engine cylinders and have difficulty in finishing them without the deposit blistering badly. Our contract calls for "heavily coppered cylinders, nickel-plated", and by inspection we find that it is the copper which is raising from the iron. We copper-plate the cylinders 45 minutes in a warm copper solution containing cyanide. The solution registers 12 degrees on the hydrometer and is worked with six volts. As we are exceptionally careful when cleaning the pieces we believe the solution at fault.

If your copper solution is rich in cyanide and contains the proper amount of metal, blistering should not occur when the current is regulated to supply about six amperes per square foot of cathode surface. If the solution is green and the anodes oat over quickly, the solution requires cyanide sufficient to produce an amber colored solution and keep the anodes free from heavy black coating for at least 10 hours. The deposit would then be a pinkish red. Reduce the density of the solution to about eight degrees, then bring up the amber color by additions of cyanide. Do not force the deposit by too strong a current and use about four volts tension, with the temperature of the solution at from 120 to 180 degrees Fahr., and you will obtain good results if the cylinders are clean. Clean them by boiling a few minutes in any good cleaning solution which is kept clean and does not cause an oxide to form on the work. Rinse in cold water and thoroughly cool before scouring; then scour with pumice, rinse again and immerse in a strong cyanide dip; then pass direct into the copper solution and strike with full current for a few seconds; next reduce the flow until only a moderate liberation of gas is noticeable. Continue at this rate for 30 minutes, or even less, and, we believe, the result will equal the 45-minute deposit. Muriatic acid, used as a dip for gray iron castings previous to coppering, is entirely useless and is liable to cause failure after the cylinder is in use. A 20 to 30-minute deposit of copper from a well balanced bath operated with proper current will afford adequate protection under a reasonable coating of nickel. We believe you have tried to force the solution when it was deficient in cyanide. Soda of any kind is not absolutely essential. Keep the solution simple and its maintenance will be comparatively easy. Additions of hyposulphite of soda are frequently the cause of blistering and such additions, in any case, should be very small, not over 3 ounces to 100 gallons of solution. The soda acts as a clearing medium, but if the cylinders are buffed after coppering, the simple cyanide and carbonate solution is the safest and most dependable for your purpose.

Lacquering Small Castings

Kindly inform us how we can dip and lacquer small castings.

To finish small brass or bronze castings in the manner mentioned, it is customary to first tumble them, unless they have been machined sufficiently to remove the rough surfaces and are free from burrs. The dipping operation merely imparts a clean surface of high color and is performed by using a solution consisting of sulphuric acid, 1 gallon; nitric acid, 3 quarts and a small handful of common salt. When mixing these acids place the nitric acid in a stoneware crock and pour the sulphuric acid into the nitric. Stir well and then add the salt. When replenishing the dip, add 1½ parts sulphuric acid and one part nitric acid and very little, if any, salt. The castings are cleansed in a potash solution and removed therefrom and allowed to cool and dry without rinsing in water. The potash forms a film over the surface of the casting which, when cool, is dipped momentarily into the acid solution and then rinsed in cold, running water. This procedure avoids conveying an unnecessary amount of water into the dip. If the solution fails to color when freshly made, allow it to cool, as the mixture generates considerable heat. If the color is dull when the solution is cool, add a small amount of cold water, but remember too much water will cause a rough surface instead of a smooth, lustrous surface to be imparted to the castings.

After rinsing in cold water, the castings are passed through clean, boiling water, and if of sufficient body to dry quickly, they are dried by swinging in the air, or if very small or thin, they should be dried in clean, hardwood sawdust, which must be entirely removed either by brushing or by using a riddle. The castings then should be lacquered with as little delay as possible. It is essential that the castings be perfectly clean and free from moisture. Therefore, we would advise drying the castings while still on the wires or holders and avoid handling. If the pieces are to small to permit the use of wires or holders, place them on small trays made of wire netting of suitable mesh. In any event, the lacquering should follow the bright acid dipping as quickly as possible and get the article coated and hung up to dry as soon as conditions will permit.

The lacquer should be of such nature as to cover the article without affecting the lustre or obscuring the metal; in short, the lacquer must be invisible and a good grade of celluloid lacquer will be found to give the best possible results. It does not crack nor peel, but should only be used by dipping or spraying. Allow the castings to accumulate so that the lacquering may be carried out with as little waste as possible. Dip in the lacquer, remove, drain and dry in a chamber free from dust and at a temperature of from 85 to 95 degrees Fahr., until the odor peculiar to the lacquer is scarcely noticeable. If a gold tint or other shade is desired, the coloring is added in very small quantities. Ordinary spirit lacquers are cheaper, but the application of these changes the appearance of the article treated to a considerable extent and are not as durable.

The various lacquers all may be made by the operator, but it is not economical to do so as the lacquers furnished by manufacturers are better and cheaper in the end. Porcelain or stoneware vessels are best for containing the lacquer while in use, although tin is largely used. If rainbow colors are noticeable after the first coat, a second dipping will usually remedy it. If the lacquer becomes thick, a thinner of the same grade as the lacquer should be used. Green-colored drops at the draining point indicate acid contamination, and the castings should be more thoroughly rinsed after bright dipping. Lacquering requires practice to produce first class results, but the use of good materials simplifies the process. When ordering lacquer, specify the class

of goods you desire to finish and the metal.

If a drying chamber is used, it should be heated by steam if work is being done regularly, as the chances of fire are lessened, the lacquering material being very inflammable. If gas is used, extra caution is required and the chamber should be of sheet steel properly ventilated. The work should be dried slowly in the open air until all dripping ceases before being placed in a drying chamber. When the coating has set and dried, the temperature of the heater may be raised and the lacquer will thus become harder, tougher and practically non-porous.

Electro-Silvering Porcelain

I desire a formula for electro silvering porcelain in relief.

Silver deposits on porcelain or glass are successfully obtained only after careful trials and you, therefore, are advised not to anticipate perfect specimens from first attempts. One fault, quite common with many methods, is the failure of the deposit to adhere to the article treated and in the following method this trouble is avoided if reasonable care is observed. To obtain a rapid, smooth deposit of fine grain the chloride of silver solution is preferable for depositing. This is made by reducing 8 ounces of silver to a nitrate, then precipitate as a chloride and wash thoroughly. This will make 1 gallon of solution by placing the chloride in the water and dissolving with C. P. potassium cyanide. The solution should contain only enough free cyanide to facilitate easy deposition with about ¾ volt. When the silver plating solution is prepared the next procedure is to prepare the paint which is applied to the article and fired before placing in the depositing solution. Dissolve ½ ounce of fine silver in equal parts of nitric acid and water and when in complete solution, pour it into 2 quarts of cold water; then filter through paper filter and place the clear nitrate solution in a deep vessel. Have ready some object which may be inverted over the deep vessel so that the contents may be kept in the dark during the next step or remove to a darkened room and precipitate the silver to a powder by suspending a few clean, copper wires in the solution contained in the jar. Allow the jar to remain undisturbed until precipitation is complete, or apparently so; then remove a cupful of the solution and add to it a few drops of hydrochloric acid. If no precipitate is obtained, the nitrate solution contains no silver and is poured off the metallic powder and thrown away; then wash the powder several times carefully. Have ready a small lead dish, into which place the silver powder and cover the powder with hydrofluoric acid and set aside for four or five hours. This is to clarify the powder. It is then separated from the acid and washed well, then placed on a clean piece of china and dried by slow heat. Do not attempt to hasten the drying as best results are obtained by slow drying. Now take the dry powder and mix with water on a slab of glass and grind it as fine as possible with a plate-bottomed pestle. Patience at this stage will be rewarded as the best pigment is the result of time and labor devoted to grinding the powder. Next allow it to dry in the air and when all moisture is removed, repeat the grinding operation using turpentine instead of water; then dry again. Now take ½ ounce of the silver powder and grind in turpentine with ½ pennyweight of mercuric oxide and a small quantity of nut oil. The paint is applied to the article with a soft, fine brush, using care to leave the painted surface smooth. The article then is hung in a suitable kiln for firing. It is also essential that the firing be carefully done as the proper heat is only ascertained by experience with different wares and the success of the entire treatment hinges on the firing. When fired, the silver deposit is obtained in the chloride bath previously mentioned and is finished on a Canton flannel buff. The time required for plating naturally depends on the class of work. There are several cheaper methods, but the results are inferior to the products of the above process. The silver paint may be purchased ready prepared, but as with a solution, it is to your advantage to prepare your own paint.

How to Daub the Cupola

By W J Keep

QUESTION.—We operate a 20-inch cupola continuously, the heats lasting nine hours each day. Our daubing mixture consists of four parts of broken fire brick, three parts of fire sand and five parts of fire clay. The mixture is made dry and then is soaked for 12 hours. Can this mixture be improved?

Answer.—Broken fire brick should not be used and if you have facilities for grinding the brick into a fine sand, it would be advisable to pursue this practice. The daubing material should be as smooth as possible to prevent injury to the hands when spreading it. The less daubing employed, the better. Whenever a brick or two burns out, chip out what remains and cement-in new bricks. If there is a cavity where a thin piece of brick can be cemented-in and not fall out again, it will answer the purpose, but a daubing mixture filled into a hole will shrink when dried and will fall out or will melt out when the cupola is in operation. The use of broken fire brick undoubtedly is for the purpose of reducing the shrinkage of the daubing mixture. Each piece of brick added should be anchored so that it cannot be displaced. After the lining has been built-up with new brick, spread a thin coating of daubing over the surface to fill up the cracks and to keep out the blast. When picking the cupola lining in the morning, if you do not pick off the slag to expose the brick, many holes will fill themselves. The best daubing material consists of ground graphite crucibles. This should be mixed with clay wash and if applied in a thin coating, it will not fall or burn off. In such a small cupola, which is run continuously, the tuyere capacity should be quite large so that the blast pressure can be kept below five ounces.

For your work you can operate almost entirely on stove plate scrap, broken small, with just enough southern iron to give it life and fluidity. Marble is an excellent flux and you should keep the slag fluid and running freely out of the cupola.

United States Match Plate Co.

The United States Match-Plate Co., Holyoke, Mass., recently has been incorporated with $10,000 capital by Fred T. Hipkins, president and general manager; George Spanos, secretary, and Charles Manos, treasurer. This business was established in October, 1913, and the company recently has been compelled to move into larger quarters. To increase its melting capacity four or six brass furnaces of the latest type will be installed. The company makes a specialty of producing match-plates and other specialties for machine molding and is in position to furnish match-plates, pattern plates, etc., from any type of pattern. In addition to manufacturing match-plates, etc., the company makes brass, composition and aluminum castings.

How to Operate a Cupola Charging Machine

Beneficial Results From Experiments Directed to Obtain the Best Results From the Equipment

By E C Kreutzberg

WHERE the tonnage melted is sufficiently large, charging the cupola by mechanical means undoubtedly is more economical than the employment of unskilled labor. Although the initial expense of installing the equipment to be used in connection with the charging machine is considerably larger than is entailed when the charging is to be done by hand, this feature, in most cases, meets with little objection. A serious complaint which frequently has been lodged against the charging machine, however, is that it is sometimes very difficult to get accurate and satisfactory results in mixing the iron.

That the charging machine, however, can be made to produce uniformly satisfactory results when operated properly, is illustrated clearly by the apparatus which has been in use at the plant of the Quigley Furnace & Foundry Co., Springfield, Mass., since April, 1913. Realizing that one of the heaviest items of expense entering into the total cost of producing castings was that of raw material, and that a saving in the cost of melting iron would have a much greater bearing on the total cost than a corresponding saving in the foundry proper, this company originally considered that the installation of a charging machine would put it in an advantageous position. This expectation has been realized, but it required several months of careful study and observation before the use of the machine was reduced to a science.

The Charging Device

The charging device, as shown in Figs. 1 and 2, consists of steel trap doors on both sides of the cupola, which are connected to the charging floor with hinges on the cupola side. These doors are level with the charging floor, and are provided with narrow-gage tracks, which connect with similar tracks on the floor proper. The doors are operated by air cylinders. Skips containing charges of pig iron or coke, previously loaded and stored on the charging floor, are deposited on cars as required, and these are then run onto the charging machine, clamped in place and elevated, thus dumping the charge into the cupola. This operation is shown in Fig. 2. The charging machine then is dropped back into the horizontal position and the cars are unclamped, rolled off and loaded with fresh skips.

The skips are loaded onto the cars by means of a traveling crane. With this exception, all the work on the charging floor is performed by one man. The valves which control the hoists are attached to the cupola, being located within easy reach of the operator. The hoists operate on 80 pounds air pressure and each has ample capacity for lifting the car and charge. The cupola doors, as shown in Fig. 2, are provided with chutes for guiding the material and are also fitted with screens, which slide in vertical grooves. The latter are used for the protection of the workman who repairs the lining of the cupola for each day's heat.

When the charging machine first was put in operation, difficulties were encountered in securing heats of uniform quality and temperature. It was discovered finally that by adopting a certain sequence in the method of charging the materials, all trouble of this sort might be eliminated.

The method of charging, which finally was found satisfactory, is as follows: Through one of the two charging doors a skip load of iron is dumped and this is followed by a charge of coke through the door on the opposite side. Next comes a charge of iron through the door last used for the coke charge, while a new charge of coke is put through the first door. This sequence is kept up throughout the heat, with uniformly successful melting results.

The raw material department of the

FIG. 1—CUPOLA EQUIPPED WITH MECHANICAL CHARGING APPARATUS

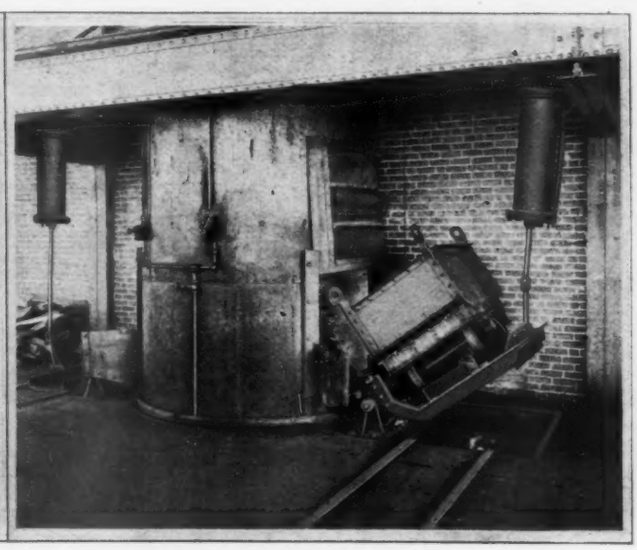


FIG. 2—DUMPING A CHARGE INTO THE CUPOLA

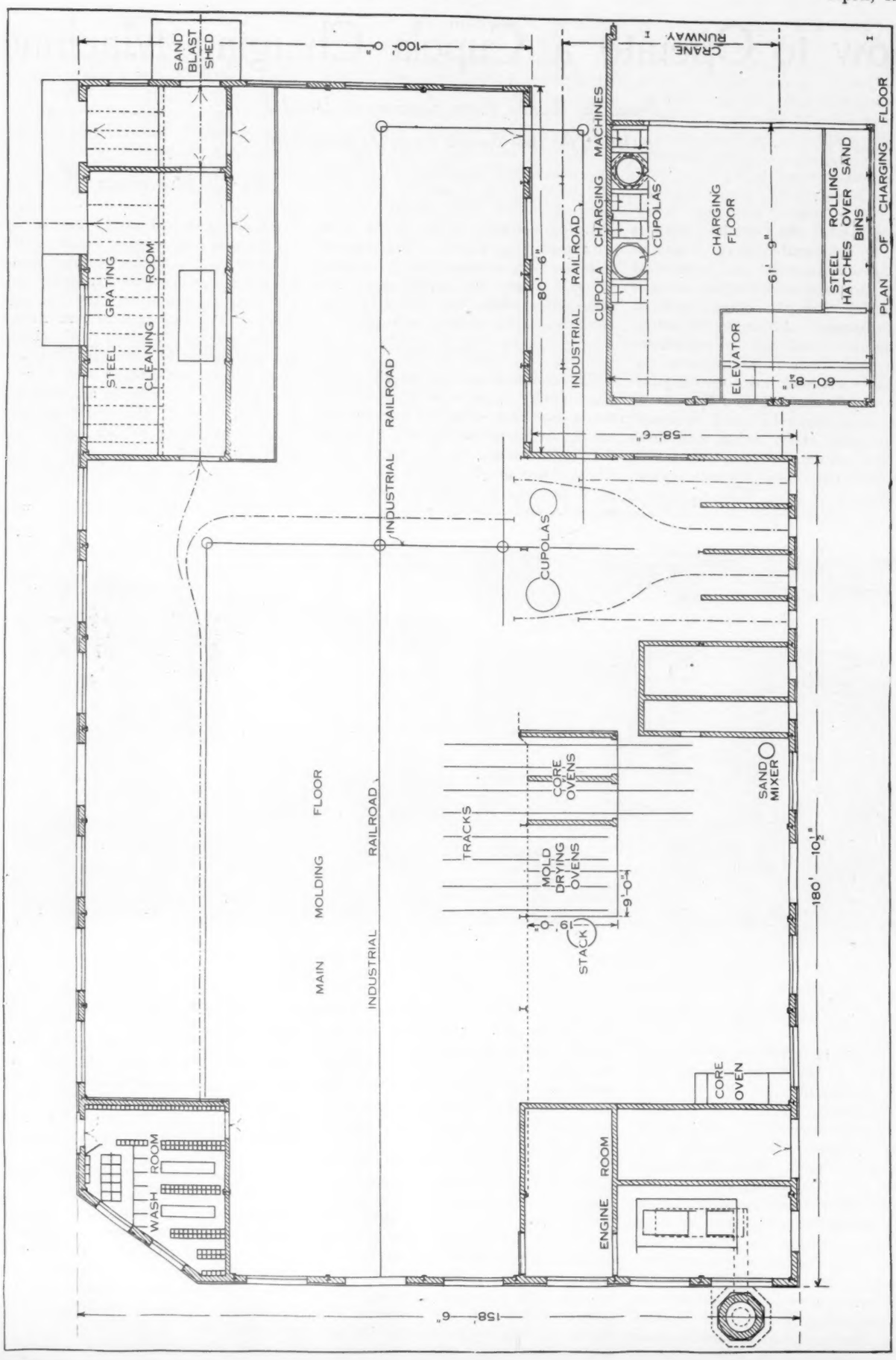


FIG. 3—GENERAL LAYOUT OF THE QUIGLEY FURNACE & FOUNDRY CO.'S PLANT

FIG. 4—PIG IRON STORAGE YARD, SHOWING TRAVELING CRANE PROVIDED WITH SCALE FOR WEIGHING CONTENTS OF SKIP

Quigley plant is designed throughout to afford the greatest possible efficiency and economy in the handling and storage of materials, and no expense was spared in achieving this end.

The central unit of this system is a 10-ton, electric crane, which travels on a runway, 220 feet long, at a height of 30 feet above the ground level. This commands the cupola charging floor, the sand and coke storage bins, the pig iron storage yard and the incoming railroad track. For carrying coke, pig iron and other materials, it is provided with a full complement of specially designed skips. They are made of riveted tank plate, and are provided at each corner with rings, which are engaged by hooks on the crane hoist. The skips have flat bottoms and one side is left open in order that the contents may be discharged readily into the cupola; the opposite side extends beyond the bottom plate in the form of a flange, which prevents the skip from sliding off the charging machine when the latter is in the inclined position. The skips are loaded with the materials for each day's heat and are deposited on the charging floor by means of the crane. The weighing is done by a crane scale, as shown in Fig. 4. This automatically deducts the tare, represented by the carrying chains and the skip, thus giving the net weight of the charge.

The skips also are employed in transporting foundry scrap to the charging floor. For this purpose they are placed on industrial cars and run through the foundry, where they are loaded with the discount and cupola scrap. They are then run out into the pig iron yard, where the skip is picked up by the crane. In addition, the skips are used for transferring material from the incoming freight cars to the brick and sand storage bins located beneath the charging floor. These include four molding sand bins, each 10 x 20 feet; one coke bin, 11½ x 33 feet, and one core sand

FIG. 5—INTERIOR OF SAND BIN

bin, 6½ x 33 feet. All the bins are 20 feet high. The latter two are open at the top, while the molding sand is dumped through hatches in the charging floor, as shown in Fig. 6. The hatches are mounted on roller bearings, which permit them to slide back under the floor.

The charging floor, which is 58½ x 60 feet, is 20 feet above the ground level. In addition to the traveling crane, it is served by an elevator. The floor itself is of steel plate construction, supported on steel I-beams.

Metal is melted in two cupolas. One, 66 inches in diameter, has a melting capacity of 18 tons per hour, and the other, 48 inches, has a capacity of eight tons per hour. The latter is charged by the usual hand method, the mechanical device not yet having been extended to include it.

The cupolas are supplied with air from a compartment which is elevated above the floor level, thus economizing on floor space and at the same time making it difficult for anyone but the operator to approach the blowers. The blast for the larger of the two cupolas is furnished by a centrifugal air compressor, which is direct-connected to a 50-horsepower motor. It can be made to furnish air at any pressure up to 18 ounces, but the usual operating pressure is 14 ounces. The blast for the smaller cupola is furnished by a blower of the positive type, operated by a 35-horsepower motor. The blast pressure on the smaller cupola also is 14 ounces.

The Quigley company produces castings both for its own use and for the jobbing trade, and, as a rule, its output includes a varied line, such as pump and automobile castings, machine tool parts, turbine castings, melting and annealing pots, candy machinery parts, ammonia cylinders, ice machinery castings, etc. The company makes a specialty of producing chilled gray iron castings, principally for tire manufacturers. The manufacture of these castings naturally necessitates the use of a number of different cupola

mixtures in order to secure grades of iron which will meet the varied requirements, and frequently changes in the analysis must be effected several times in the same heat.

The method of separating the different grades in the cupola follows: A certain desired mixture is charged into the furnace in the quantity required, the usual amount of coke being introduced between charges of 2,000 pounds of metal. When the mixture is to be changed, a separation is made by using additional coke between the last charge of the first special grade and the first charge of the new special grade. This method increases the consumption of coke and retards the rate of melting, but it has been found much more economical than operating an increased number of cupolas. Five different grades are sometimes run out in one heat, and, by the exercise of care on the part of the operator who distributes the charge, and the man who taps the furnace, the test bars of the different grades seldom show any miscalculation.

Hydraulic cylinders and castings requiring a close grain, high tensile strength, and wearing qualities almost equal to those of steel, are produced from a mixture which analyses 1.30 per cent silicon, 0.91 per cent manganese, 0.20 per cent phosphorus and 0.08 per cent sulphur. For metal used in the production of special plates that are designed to supplant steel, and are at the same time to be machined, a mixture is used which shows this analysis: Silicon, 0.90 per cent; phosphorus, 0.18 per cent; manganese, 0.90 per cent, and sulphur, 0.07 per cent.

In mixing special iron, it has been ascertained at the Quigley plant that it is possible to melt steel rails and high phosphorus iron, having a phosphorus content of 1.10 to 1.42 per cent, in the ratio of 1,600 pounds of the former to 400 pounds of the latter, to produce a metal which can be machined and which has a tensile strength of 40,000 pounds per square inch. The shrinkage is very high, but the finish is equal to steel and this mixture is particularly suitable for drill press columns or pump plungers. The high phosphorus content, it is believed by the company, has a tendency to keep the metal in a liquid condition at a lower temperature than usual, thus causing the segregation of graphitic carbon in quantities sufficient to make the casting soft enough to machine. This metal has not been adopted for regular practice, and is produced only occasionally.

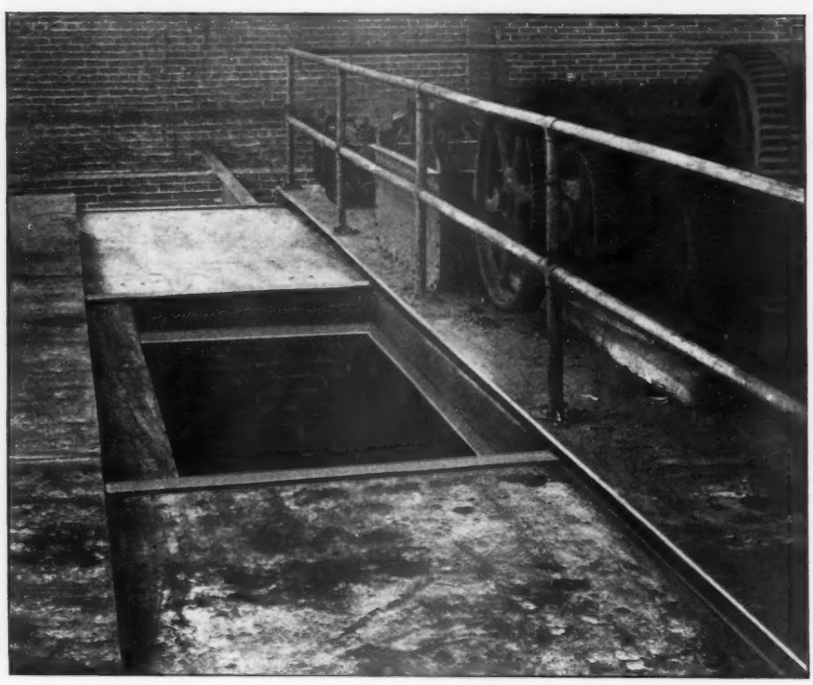


FIG. 6—HATCHES FOR UNLOADING SAND INTO BINS

In making long machine tool beds, the tendency to warp through unequal shrinkage is overcome by making allowances for such warping in the patterns. Thus on a bed, 20 feet long, having two sides and a top plate, the mold is made concave, with the middle portion 1½ inches below the ends. The ends are drawn downward as a result of the shrinkage, and the casting thus becomes straight.

A great many gray iron castings are produced at this foundry in dry sand molds. For these, Milville gravel, Lumberton sand and flour are used, the mold being dried after its surface has been covered with wet blacking. Dried molds are used in producing ammonia, hydraulic and steam cylinders.

The foundry is provided with the latest hoisting and transportation devices. These include two 10-ton electric traveling cranes which span the center bay and travel the full length of the building; two three-ton electric hoists, and one 10-ton hand-operated jib crane. The shop is equipped throughout with a narrow-gage railroad and an overhead monorail system, with branches reaching all departments. The heating system is of the overhead, hot-air type. The air is heated by exhaust steam from the engine room, air being induced through a series of steam coils by an engine-driven fan located in a compartment above the engine room. From this point, the heated air is distributed, traveling through a circulation system made up of 800 feet of galvanized pipe, ranging from 48 to 10 inches in diameter. The air is discharged at various points in the foundry at about 10 feet above the floor level.

Mold-Drying Ovens

The foundry is provided with two car-type mold-drying ovens of the Quigley type. Each is 9 x 19 feet and 10 feet high, of steel and brick construction, with combustion chambers and arches of fire brick. They were designed primarily to secure economical consumption of fuel and a uniform distribution of heat. The combustion chamber is in the center of the oven and is covered by a brick arch, which is provided at intervals with openings for admitting the heated gases. An air current, which enters the heating chamber after passing through the hollow tile lining of the combustion chamber furnishes an auxiliary supply of heat which otherwise would be wasted. This method of adding to the volume of heated air and gas passing through the furnace, it is estimated by the company, decreases the fuel consumption approximately 33-1/3 per cent. At the top of the oven are vents which are opened when green molds are placed in the heating chamber. After the vapor has passed off, these vents are closed and the gases then make their escape through ports in the floor, which open into the flues leading to the stack.

The doors are of unusual construction and are designed to permit as little heat as possible to escape by radiation. They are built of two layers of sheet steel, which are lined with asbestos and separated by a 3-

inch air space. A pyrometer test has shown that with the temperature inside the oven at 500 degrees Fahr., and the atmospheric temperature at 80 degrees, the temperature on the outside of the oven door was 160 degrees. Thus the difference between the temperature of the outer surface of the oven door and the atmospheric temperature was 80 degrees Fahr., which kept the heat loss through radiation at a minimum. Another advantage derived from the use of this type of door is that the difference in temperature between the middle and ends of the oven is very small, thus making the heating efficiency practically uniform from end to end. The bottoms of the doors are provided with narrow strips of channel steel which fit into wider channels in the floor when the door is closed. The floor channels are filled with sand which effectually prevents the escape of heat from the interior of the oven. It likewise prevents the admission of cold air.

Use of Molding Machines

The foundry is provided with compressed air attachments for the operation of pneumatic rammers, vibrators, etc. Most of the molds are made by hand, although several molding machines have been installed. Three jar-ramming machines have been rigged up for the production of molds for candy machinery castings. For making pulley molds up to 36 inches in diameter with any width of face, two machines of the Delano type are employed.

The core room occupies a space in the south bay, 58 x 80 feet. It is equipped to accommodate 36 coremakers. It is served by a three-ton, 21-foot span, floor-controlled, electric traveling crane, and in addition to the usual storage racks, contains a sand-mixing machine of the Sellers type. Later it is planned to install a 36 x 42-inch jar-ramming machine for making large cores.

This core room also is equipped with a battery of two reel type core ovens, manufactured for the foundry trade by the Quigley company. The five circular shelves, or reels, are of cast iron, made heavy enough to resist distortion by the heat. They are cast in halves, each half being bolted to a central, vertical partition, which is amply insulated with air-celled asbestos on both sides to prevent heat losses by radiation. The shelves are mounted on a vertical shaft and rest on ball bearings so that each may revolve independently of the others. By this arrangement, baked cores can be removed from the oven and replaced by green cores in continuous succession and without loss of time or baking efficiency. The combustion chamber is located underneath the oven, the heated gases passing up into the heating chamber through a series of openings in the arch covering the former. From the heating chamber, the waste gases pass out through wall flues, which are provided with dampers for regulating the draft. In order to facilitate drying in the center of the heating chamber, which usually is the coolest portion, an auxiliary current of air, which derives its heat from the walls of the combustion and heating chambers, is sent through this area. By this means, a saving in fuel consumption is effected and the volume of air passing through the furnace is increased. The ovens are of steel frame and red brick construction, with the exception of the combustion chamber and the arch covering it, which are of fire brick. These ovens also are provided with vents.

FIG. 7—MOLD DRYING OVEN OF THE QUIGLEY TYPE

The core department also is provided with two core ovens of the same size and general construction as the mold drying ovens previously described. The core ovens, however, are provided with doors at both ends, so that cars loaded with green cores may be run in at one end, and, after the baking is completed, may be removed at the other end, this area being commanded by the crane serving the main bay of the foundry.

The floor of the cleaning room constitutes one of its most novel features. It is made of steel grating, through which the sand falls, thus eliminating the dirt that is usual in this department of a foundry. From the compartment beneath the grating, the accumulated sand is carted away by means of an inclined drive-way, which leads to the yard. The cleaning room is provided with three exhaust tumblers, 36 x 52 inches, and one 24 x 36 inches. In addition, it is equipped with grinding wheel stands and pneumatic chippers. A chamber for housing the sand blast equipment is located immediately alongside the cleaning room and communicates with the latter. The cleaning room is located in the north bay, where it is partitioned off from the foundry proper. Outside the cleaning room, extending for a few feet into the main bay, is a concrete landing, on which heavy castings may be deposited by the crane for treatment in the cleaning department.

The machine and assembling departments are equipped with all the tools necessary for fabricating and assembling the apparatus which makes up the Quigley company's main product. This embraces all kinds of pulverized coal, coke, oil and gas burning furnaces and equipment. Adjacent to this department is a smaller building, in which are conducted tests and demonstrations of pulverized coal-burning furnaces.

The plant at present consists of the foundry, 158 x 260 feet; a 50 x 100-foot pattern storage, three stories; a one-story pattern shop, 20 x 40 feet; an office building, and the machine and assembling department. The latter department soon will be housed in a new building, 100 x 200 feet. It will be of brick and steel construction, with two bays and will be provided with traveling cranes, etc. The foundry is provided at the east end with a curtain wall, which may be removed to permit of extensions.

In laying out the power plant, provision was made for the future installation of an additional unit. The

power plant occupies a corner of the south bay of the foundry, and is 31 x 67 feet. This is divided off, by a brick partition, into the boiler room, 31 x 40 feet, and an engine room, 27 x 31 feet. The present power plant equipment consists of a 150-horsepower, horizontal boiler, which is provided with feed pump and a Cochrane feed water heater; a 150-horsepower Westinghouse turbine, direct-connected to a 100-kilowatt generator and a compound steam-driven air compressor. The boiler and engine room floors are concrete and are drained by underground ducts which are covered with steel floor plates.

The Quigley Furnace & Foundry Co. was organized in June, 1912, and immediately started work on the erection of its plant. The first heat in the foundry was poured April 1, 1913, and heats have been run every working day since that time. At a receiver's sale last May, the Quigley company took over the patents and good will of the Rockwell Furnace Co. The main offices, including the executive, sales and engineering departments, are at 105 West Fortieth street, New York.

The officers of the company include D. Van Alstyne, president; W. S. Quigley, vice president and general manager, and Paul Ramp, works manager.

Plaster Pattern for a Conveyor Screw

By William J Carew Jr.

I ONCE was obliged to make a pattern for a large cast iron conveyor screw and owing to the expense involved in building it of wood in the ordinary manner, I decided to try plaster of Paris. The result was satisfactory and considerable time, labor and expense was avoided. The screw was for a machine designed to wash oil from threaded fittings. It was 24 inches in diameter with a 16-inch pitch, the blades being ⅝ inch thick. The hub was 6 inches in diameter. The screw was cast in sections equal to one-half the pitch, which were bored and keyed to a 3-inch steel shaft.

I first made a pattern board 24 inches in diameter, 1½ inches thick and located a temporary hub, *D*, Fig. 2, at the center. This hub was 5⅜ inches in diameter and 8 inches long. I then determined the length of the outer bottom edge of the screw blade by laying out a line on paper equal to one-half the circumference of the screw, 37.68 inches. At right angles to one end of this line, I laid off a line 7⅜ inches long and connected its extremity with the first line, thus forming a right triangle. When this triangle was bent around the edge of the pattern board, its upper edge would form a line which represented the outside bottom edge of the screw.

As it was necessary to have guides for each end of the strike or sweep, they were made by cutting a number of strips 1 inch wide and ⅝ inch thick for the outside guide and ½ inch wide and 5/16 inch thick for the inside guide. The strips were made carefully, it being important that their tapering width be accurate. They were laid out as shown at *A* and *B* in Fig. 1 and finished to the proper length. The thickness pieces, *C*, were made at the same time. The guide strips then were attached to the board and hub, as shown in Fig 2. The form was shellaced and swept up with a mixture of half plaster of Paris and half molding sand. Care was taken to keep the sweep level while drawing it back and forth across the plaster. This requires considerable skill as the plaster sets quickly and in the hurry attendant on the operation, the job may be finished in a poor manner. Two men should be available, one to handle the sweep

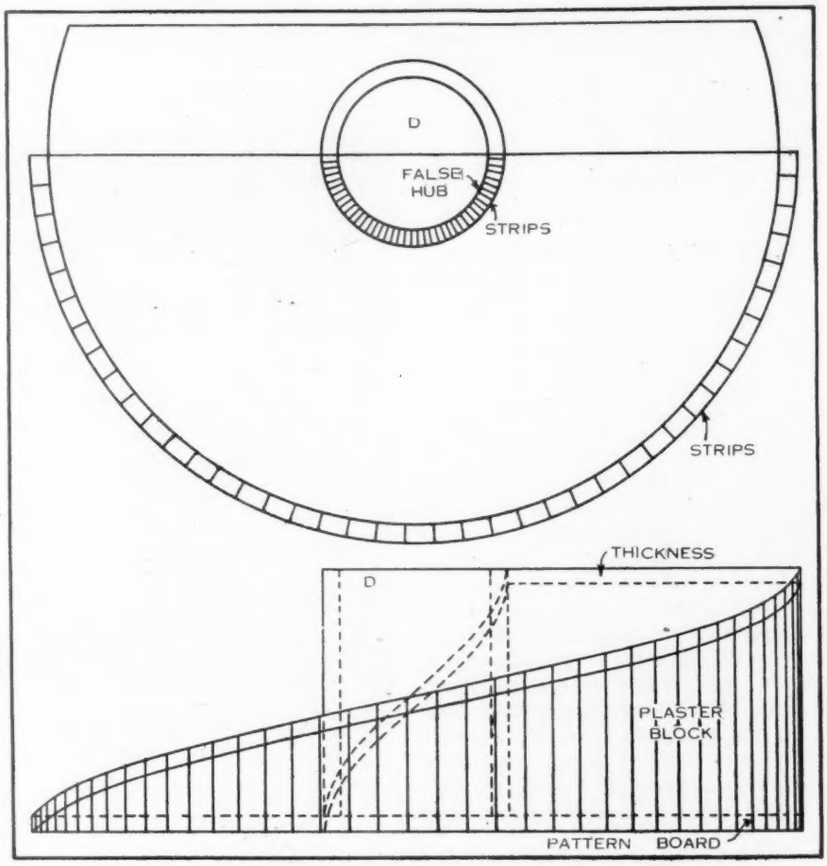


FIG. 2—PLASTER PATTERN READY FOR THE SWEEP

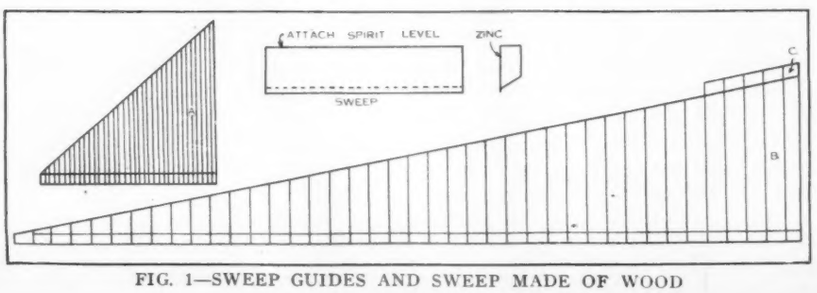


FIG. 1—SWEEP GUIDES AND SWEEP MADE OF WOOD

and the other to apply the plaster. The block should be carefully tested with the sweep after it is hardened.

The thickness pieces, *C*, were next fastened to the ends of the strips and the whole affair was well shellaced, after which the blade of the screw was swept up with pure plaster of Paris.

An iron pattern with the proper finish was made and substituted for the temporary wood hub. A follow-board also was made. When the castings were machined and slipped over the shaft the job proved satisfactory, although it was not scientifically correct.

The operations described could probably have been successfully performed by a skilled sweep molder provided with the board, strips, hub, strike, etc., but we had no such a man at hand at the time and the plaster of Paris stunt seemed to be the best way out.

Large Manganese Bronze Castings

The Exeter Machine Works, Pittston, Pa., is now filling an order for more than 1,000,000 pounds of manganese bronze castings for valves for the Board of Water Supply of the city of New York. The casting shown in the accompanying illustration is a shell for a 48-inch riser valve and weighs 23,000 pounds. The total weight of this valve when completed is 30,000 pounds. A number of these valves similar to the one shown and 72 inches in diameter also are being made. The total weight of each one of these completed valves is 46,000 pounds. The tensile strength of the manganese bronze entering these castings in many cases exceeds 75,000 pounds per square inch and the tensile strength of rods forged from this metal exceeds 80,000 pounds. The Exeter Machine Co.'s capacity for pouring manganese bronze is 20 tons.

SHELL FOR 48-INCH RISER VALVE MADE OF MANGANESE BRONZE; WEIGHT 23,000 POUNDS

Burning Gray Iron onto Steel

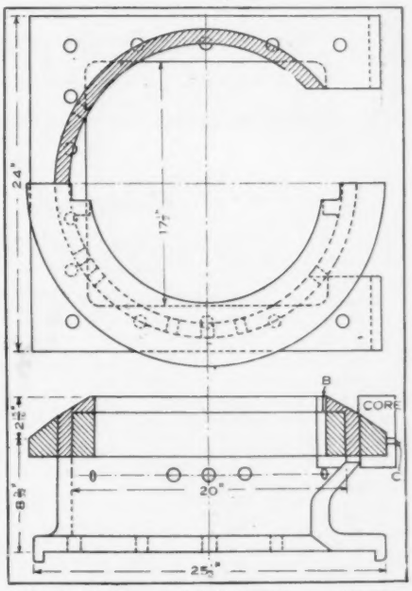
By J. F. Webb

At the plant of the Davenport Locomotive Works, Davenport, Ia., a cast steel center plate for a geared locomotive recently was received, but it was found that the bearing for the top plate was not sufficiently large for the purpose intended, and it was suggested that an effort be made to burn on sufficient cast iron to obtain a good bearing. The work was done successfully and so thoroughly was the iron welded onto the steel that when the casting was machined the chips clearly showed the two metals and there was no line of cleavage between the steel and the iron. In the accompanying illustration is shown a plan and sectional view of the casting with the gray iron which was cast onto the steel clearly indicated. The steel was cleaned with acid to thoroughly remove the rust after which the surface, onto which the gray iron was to be burned, was painted with red lead and gasoline. The steel casting then was placed on a level bed and dry sand cores were used for the mold. Six cores were placed both on the inside and outside of the castings, and after they were set in position molding sand was rammed around them to hold them in place. Twelve gates were cut in the sides of the mold, ¼ x ½ inch in size. A basin and runner sufficient to hold 200 pounds of iron then was built above the mold into which 1,600 pounds of cast iron were poured. This large amount of iron was used to heat the steel and the surplus iron was run off through the opening, *C*. The location of the gates are shown at *B*, and the dry sand cores are clearly indicated. After a sufficient amount of iron to heat the steel casting was run through this opening, it was stopped-off and the mold was filled with molten metal. To carry off the iron from the inside of the mold, six 1-inch holes were drilled in the steel casting and formed an excellent outlet for the surplus iron. Approximately 1½ inches of gray iron were machined off and the weld between the iron and steel was found to be perfect.

McLain's System

McLain's System, Goldsmith building, Milwaukee, recently has issued two booklets devoted to its course in foundry practice, particularly relating to the production of semi-steel. One booklet contains 48 pages and is replete with testimonial letters from students of this school who have been greatly benefited by this course. Numerous views of semi-steel castings also are included, together with sketches of a large number of successful foundry foremen and superintendents who testify to the value of McLain's course. The other booklet is entitled "A Story of Foundry Success", the contents being taken from the private correspondence between A. J. Witt, general manager of the Cumberland Foundry & Mfg. Co., Nashville, Tenn., and David McLain, founder of McLain's System. This correspondence reflects in detail the service rendered by McLain's System aside from the course in foundry practice furnished to the students of this school.

The necessity for larger space and better facilities to handle their increased business compelled the Indianapolis and Louisville branches of the H. W. Johns-Manville Co., of New York City, to seek larger quarters. The Indianapolis branch now is located at 408-410 North Capitol avenue and the Louisville branch at 659-661 South Fourth avenue. Both of these branches have ample warehouse accommodations in addition to show rooms for the display and sale of this firm's varied line of products.



CAST STEEL LOCOMOTIVE CENTER PLATE BUILT UP BY BURNING-ON GRAY IRON

The Hooper-Falkenau Engineering Co., New York City, recently has removed into larger quarters in the Woolworth building, occupying suite 1922-1930 inclusive. These new quarters provide greatly increased facilities made necessary by the rapid growth of this company's engineering business.

THE FOUNDRY

A monthly journal devoted to all branches of the foundry trade.

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Alloy Nomenclature

NON-FERROUS alloy nomenclature, which is in a chaotic condition throughout the brass foundry world, now is engaging the attention of British casting manufacturers, and at the recent annual meeting of the Institute of Metals, held at London, a report of a special committee was presented which attempts to solve the problem along lines different from those recommended by the American Institute of Metals. The problem is so important that it seems advisable to consider it by a joint international committee and before a definite system of alloy nomenclature is adopted, both the American and British Institutes should harmonize any differences that may exist. The committee of the Institute of Metals suggests that the coining of new names should be avoided as well as the employment of Latin or foreign terms and chemical or other symbols. It also has been recommended that where an alloy consists of more than three metals, its systematic name shall not, as a rule, contain more than the names of the three metals present in the largest proportion by weight, but the presence of additional metals or elements shall be denoted by the prefix "comp." or "complex". The term "brass" is to be used as an abbreviation of the words "zinc-copper" as employed in the systematic nomenclature, and the term "bronze" is to be an abbreviation of the words "tin-copper". The committee's report is largely an outline of its method of procedure and at a future meeting a number of practical terms will be suggested.

Trade Outlook

TRADE conditions in all foundry centers have improved, although the melt in practically all branches of the industry is still below normal. The retrenchment policy of the railroads is the principal factor affecting the volume of new tonnage and until the rate question is adjusted it is doubtful if buying will be resumed to cover new requirements. The percentage of operations of the malleable and steel foundries is less than that of the gray iron and brass shops, although the activity of the latter is attributed largely to the demand for castings for motor cars and trucks. Notwithstanding the reduced melt, foundrymen are buying new equipment liberally and machinery manufacturers report a revived interest among casting manufacturers in methods and processes that will reduce the cost of production. The advent of the spring months foreshadows increased trade activity in all lines and this improvement will be reflected in the melts of foundries generally. While sales of pig iron during March were considerably below the totals of January and February, nevertheless prices have been well maintained, and in some centers quotations have been advanced. This is due largely to the sales of iron for forward delivery, and in many instances the furnace production is not equal to the shipments. The pig iron output is not being increased and operators are showing no disposition to blow-in idle stacks. The scrap market continues in a demoralized condition and old material for foundry use is being offered at exceedingly attractive prices. In the leading centers, No. 2 foundry iron is quoted as follows: Chicago, local, $14.25; Cleveland, $14.25; Pittsburgh, $14.15 to $14.40; Buffalo, $14 to $14.25; Philadelphia, $14.50 to $14.75, and Birmingham, $10.75 to $11. Lake Superior charcoal iron is held at $15.75 to $16.75, Chicago, and malleable Bessemer is quoted at $13.50 to $14, Buffalo, and $14.75, Chicago.

BOARD FEET IN PATTERN LUMBER

By A. W. Nock

The accompanying table, which gives the number of board-feet in planks of various sizes, will be found of value to patternmakers and others in calculating the cost of lumber for patterns and flasks. The size of the pieces is given at the left and their length in the various columns across the top of the table.

Size.	Length in Feet. 4	5	6	7	8	9	10	11	12	13	14	15	16
	Feet Board Measure.												
1 x 1	0.33	0.41	0.5	0.58	0.66	0.75	0.83	0.91	1.00	1.08	1.16	1.25	1.33
1 x 2	0.66	0.82	1.0	1.16	1.32	1.50	1.66	1.82	2.00	2.16	2.32	2.50	2.66
1 x 3	1.00	1.25	1.5	1.75	2.00	2.25	2.50	2.75	3.00	3.25	3.50	3.75	4.00
1 x 4	1.33	1.66	2.0	2.33	2.66	3.00	3.33	3.66	4.00	4.33	4.66	5.00	5.33
1 x 5	1.66	2.08	2.5	2.91	3.33	3.75	4.16	4.58	5.00	5.41	5.83	6.25	6.66
1 x 6	2.00	2.50	3.0	3.50	4.00	4.50	5.00	5.50	6.00	6.60	7.00	7.50	8.00
1 x 7	2.33	2.91	3.5	4.08	4.66	5.25	5.81	6.37	7.00	7.57	8.16	8.75	9.33
1 x 8	2.66	3.33	4.0	4.66	5.33	6.00	6.66	7.33	8.00	8.66	9.33	10.00	10.66
1 x 9	3.00	3.75	4.5	5.25	6.00	6.75	7.50	8.25	9.00	9.75	10.50	11.25	12.00
1 x 10	3.33	4.16	5.0	5.83	6.66	7.50	8.33	9.16	10.00	10.82	11.66	12.50	13.33
1 x 11	3.66	4.58	5.5	6.41	7.33	8.25	9.16	10.08	11.00	11.90	12.82	13.75	14.66
1 x 12	4.00	5.00	6.0	7.00	8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00

Size.	Length in Feet. 4	5	6	7	8	9	10	11	12	13	14	15	16
	Feet Board Measure.												
1¼ x 1	0.41	0.52	0.62	0.73	0.83	0.93	1.04	1.14	1.25	1.35	1.45	1.56	1.66
1¼ x 2	0.83	1.04	1.25	1.45	1.66	1.87	2.08	2.28	2.50	2.70	2.91	3.12	3.33
1¼ x 3	1.24	1.56	1.87	2.18	2.50	2.81	3.12	3.43	3.75	4.05	4.37	4.68	5.00
1¼ x 4	1.66	2.08	2.50	2.91	3.32	3.75	4.16	4.57	5.00	5.41	5.82	6.25	6.66
1¼ x 5	2.08	2.60	3.12	3.64	4.16	4.68	5.20	5.72	6.25	6.76	7.28	7.81	8.32
1¼ x 6	2.50	3.12	3.75	4.37	5.00	5.62	6.25	6.87	7.50	8.10	8.75	9.37	10.00
1¼ x 7	2.91	3.64	4.38	5.10	5.83	6.56	7.29	8.01	8.75	9.47	10.20	10.93	11.66
1¼ x 8	3.32	4.16	5.00	5.82	6.65	7.50	8.32	9.15	10.00	10.82	11.66	12.50	13.32
1¼ x 9	3.75	4.66	5.62	6.56	7.50	8.43	9.37	10.29	11.25	12.18	13.12	14.05	15.00
1¼ x 10	4.16	5.20	6.25	7.27	8.33	9.57	10.30	11.54	12.50	13.52	14.55	15.62	16.64
1¼ x 11	4.58	5.72	6.87	8.01	9.17	10.31	11.45	12.60	13.75	14.88	16.03	17.18	18.35
1¼ x 12	5.00	6.25	7.50	8.75	10.00	11.25	12.50	12.75	15.00	16.25	17.50	18.75	20.00

(*Continued on Data Sheet No.* 160)

BOARD FEET IN PATTERN LUMBER

By A. W. Nock

A board foot contains 144 cubic inches of lumber. That is, a plank 12 inches square and 1 inch thick contains 1 board foot; if it were 2 inches thick, it would contain 2 board feet. However, in selling lumber, dealers always figure boards *less than 1 inch* thick as if they were inch boards.

(*Continued from Data Sheet No.* 159)

Size.	Length in Feet. 4	5	6	7	8	9	10	11	12	13	14	15	16
	Feet Board Measure.												
1½ x 1	0.5	0.61	0.75	0.87	1.0	1.12	1.23	1.36	1.5	1.62	1.74	1.87	2.0
1½ x 2	1.0	1.23	1.50	1.74	2.0	2.25	2.46	2.73	3.0	3.24	3.48	3.75	4.0
1½ x 3	1.5	1.84	2.25	2.61	3.0	3.37	3.75	4.13	4.5	4.86	4.72	5.62	6.0
1½ x 4	2.0	2.49	3.00	3.49	4.0	4.50	4.99	5.49	6.0	6.49	6.99	7.50	8.0
1½ x 5	2.5	3.09	3.75	4.36	5.0	5.62	6.18	6.75	7.5	8.11	8.73	9.37	10.0
1½ x 6	3.0	3.75	4.50	5.25	6.0	6.75	7.50	8.25	9.0	9.75	10.50	11.25	12.0
1½ x 7	3.5	4.36	5.25	6.12	7.0	7.87	8.72	9.61	10.5	11.35	12.24	13.12	14.0
1½ x 8	4.0	5.00	6.00	7.00	8.0	9.00	10.00	11.00	12.0	13.00	14.00	15.00	16.0
1½ x 9	4.5	5.43	6.75	7.87	9.0	10.12	11.25	12.37	13.5	14.62	15.74	16.87	18.0
1½ x 10	5.0	6.24	7.51	8.73	10.0	11.25	12.49	13.74	15.0	16.23	17.49	18.75	20.0
1½ x 11	5.5	6.87	8.25	9.61	11.0	12.37	13.74	15.12	16.5	17.85	19.23	20.62	22.0
1½ x 12	6.0	7.50	9.00	10.50	12.0	13.50	15.00	16.50	18.0	19.50	21.00	22.50	24.0

Size.	Length in Feet. 4	5	6	7	8	9	10	11	12	13	14	15	16
	Feet Board Measure.												
2 x 1	0.66	0.82	1.0	1.16	1.32	1.50	1.66	1.82	2.0	2.16	2.32	2.5	2.66
2 x 2	1.33	1.64	2.0	2.33	2.64	3.00	3.33	3.64	4.0	4.33	4.64	5.0	5.33
2 x 3	2.00	2.50	3.0	3.50	4.00	4.50	5.00	5.50	6.0	6.60	7.00	7.7	8.00
2 x 4	2.66	3.33	4.0	4.66	5.33	6.00	6.66	7.33	8.0	8.66	9.33	10.0	10.66
2 x 5	3.33	4.16	5.0	5.82	6.66	7.50	8.33	9.16	10.0	10.82	11.66	12.5	13.33
2 x 6	4.00	5.00	6.0	7.00	8.00	9.00	10.00	11.00	12.0	13.00	14.00	15.0	16.00
2 x 7	4.66	5.82	7.0	8.16	9.33	10.50	11.62	12.74	14.0	15.14	16.33	17.5	18.66
2 x 8	5.33	6.66	8.0	9.33	10.66	12.00	13.33	14.66	16.0	17.33	18.66	20.0	21.33
2 x 9	6.00	7.50	9.0	10.50	12.00	13.50	15.00	16.50	18.0	19.50	21.00	22.5	24.00
2 x 10	6.66	8.33	10.0	11.66	13.33	15.00	16.66	18.33	20.0	21.64	23.33	25.0	26.66
2 x 11	7.33	9.16	11.0	12.82	14.66	16.50	18.33	20.16	22.0	23.80	25.64	27.5	29.33
2 x 12	8.00	10.00	12.0	14.00	16.00	18.00	20.00	22.00	24.0	26.00	28.00	30.0	32.00

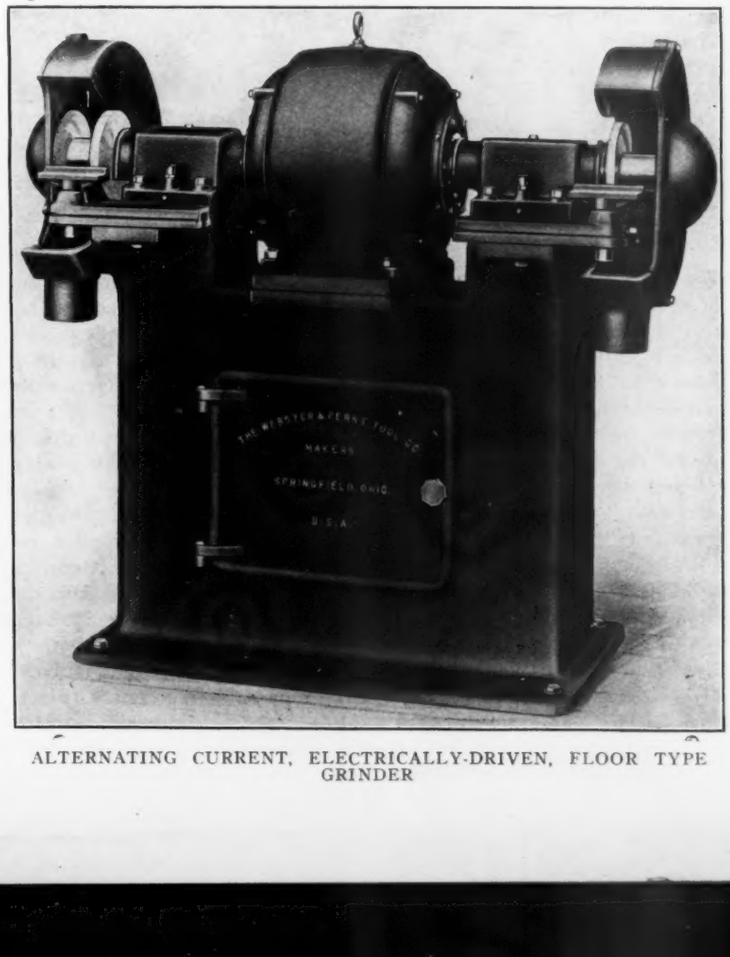
THE FOUNDRY DATA SHEET, APRIL, 1914

Payment will be made for all contributions on foundry and pattern shop practice suitable for publication

Note—This sheet may be cut into two sections, 5 x 7 inches, and may be readily bound in note-book form.

An Electrically-Driven Grinder

The Webster & Perks Tool Co., Springfield, O., is building an electrically-driven floor-type grinder, shown in the accompanying illustration, which is adapted to all kinds of grinding operations in casting plants. The rotor is wound on a hollow steel shaft mounted in a pair of ball bearings and the wheel spindle, or machine arbor, passes through this shaft, from which it is driven by a pair of dovetail steel keys. As the wheel spindle has a slightly smaller diameter than the opening in the rotor shaft, any deflection of the wheel spindle will not affect the rotor and thereby damage to the motor is eliminated. This type of construction also permits of the removal of the wheel spindle without disturbing the motor. The wheel spindle bearings are independent of the roller bearings and are mounted in self-oiling babbit bearings. The machine complete weighs 1,550 pounds and is equipped with a five-horsepower motor operating at 1,200 revolutions per minute. The machine has a capacity for carrying a pair of 16 to 18-inch wheels with 3-inch face.

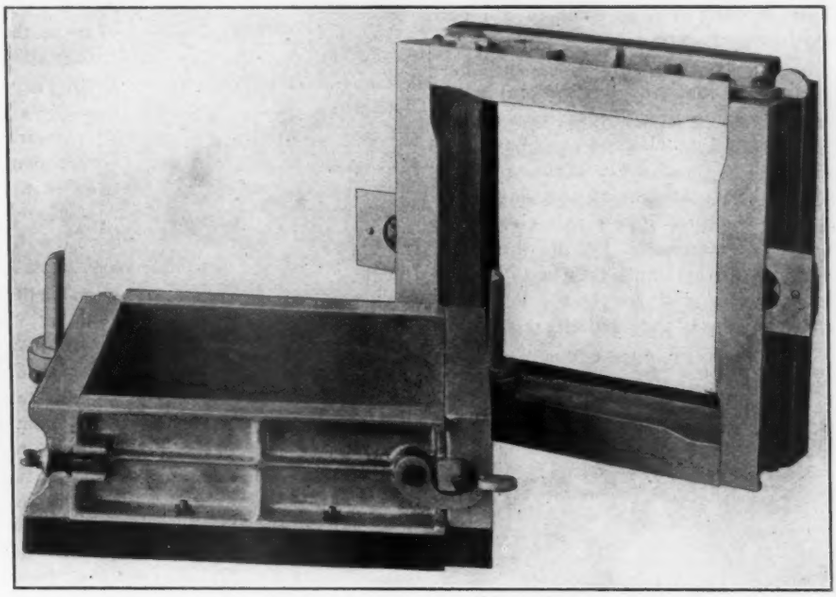


ALTERNATING CURRENT, ELECTRICALLY-DRIVEN, FLOOR TYPE GRINDER

The S. C. Carpenter Drafting & Engineering Co., Hartford, Conn., has compiled a chart by which the weight of castings can be obtained approximately from the weights of the patterns. The metals from which the weights of patterns can be estimated included aluminum, cast iron, zinc, copper, brass and gun metal and the pattern materials include white pine, yellow pine, Nassau mahogany, Honduras mahogany, Spanish mahogany and red pine. This chart will be furnished to the trade at a price of 50 cents.

Basic Mineral Co.'s Fluxes

The Basic Mineral Co., North Side, Pittsburgh, Pa., is prepared to furnish fluxes for gray iron, steel, semi-steel, malleable iron, brass and bronze. It is claimed that the semi-steel flux can be used to advantage for making the product homogeneous. One foundry operating a 36-inch cupola by the use of this flux has increased its output from 3½ to 7 tons an hour and has effected a large saving in coke consumption. The flux for brass, bronze and non-ferrous metals, known by the trade name of "Radioclarite," increases the fluidity of the metal and insures clean castings.



ADJUSTABLE AND INTERCHANGEABLE AERO METAL SNAP FLASKS

Adjustable and Interchangeable Snap Flask

In foundries doing light work, the equipment of snap flasks necessarily is large, and to reduce to the minimum the number of flasks required, adjustable and interchangeable types effect large economies. To meet the needs of the trade, the Federal Foundry Supply Co., Cleveland, has designed and is building an adjustable and interchangeable Aero metal snap flask, which, it is claimed, will reduce the snap flask investment of a shop fully 50 per cent. Instead of being compelled to carry a complete stock of flasks of varying sizes, it only is necessary to carry extra side pieces which will enable the foundryman to make flasks of a size to meet his requirements. From 11 flasks having cope ends and sides 3½ inches deep and drag ends and sides, 2½ inches deep, and cope and drag ends 10 to 18 inches long, and cope and drag sides 12 to 20 inches long, it is possible to make 121 different sizes of flasks by inter-

changing. If a deeper flask is required, the 2½-inch drag and 3½-inch cope can be built up with moisture-proof wood extensions to a depth of 9 inches. If a 10-inch depth is desired, a flask of this size is provided and this in turn can be built-up 3 inches with wood extensions.

The side and end pieces for these flasks are made of Aero metal which has the same specific gravity as aluminum and is claimed to have the strength of steel. On account of the strength of this metal the flasks are made one-third lighter in weight than if cast of aluminum. While the flasks are built in sections, they are without loose pieces and the ends and joints are machined and drilled with templates to insure a perfect fit when assembled.

A CRUCIBLE OF NEW DESIGN

In the accompanying illustration is shown a 6-inch pair of Aero metal flasks, the drag being 2½ inches deep and the cope, 3½ inches. They are equipped with wood extensions which are surfaced with strips of Aero metal.

A Crucible of New Design

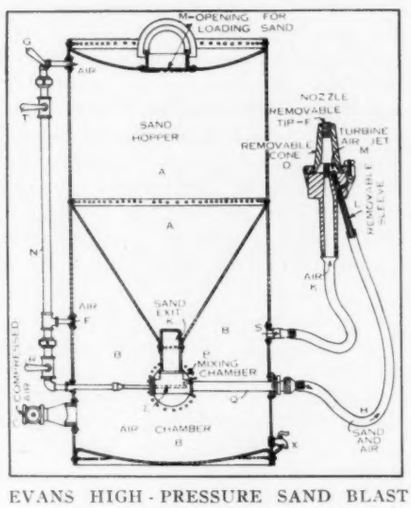
A crucible of a new type, to be used by melters of precious metals, has been designed by Henry Weisbrodt, an employe of the Joseph Dixon Crucible Co., Jersey City, N. J. As shown in the accompanying illustration, this crucible eliminates the necessity of skimming and prevents charcoal or molten flux from being carried into the ingot or casting. This crucible has a bridge at the top, which holds back the charcoal and foreign matter when pouring the metal. This design does not reduce the capacity of the crucible and the metal can be stirred satisfactorily and in the same way as in a pot of the ordinary type.

Evans High Pressure Sand Blast

A sand blast machine of the high pressure type now is being offered to the foundry trade by the Carter Metals Cleaning Co., Philadelphia. As shown in the accompanying illustration, this machine is of the double hose type, the sand flowing through one hose at a comparatively low pressure to the nozzle while through the other hose the air passes to the nozzle at a high pressure. The sand at low pressure comes in contact with the air at high pressure in the nozzle and is forced with great velocity against the material or object to be cleaned. In the accompanying illustration the sand hopper is shown at *A*, the sand being charged into the hopper at *M*. Compressed air enters the air mixing chamber from the compressor at *C*. This air chamber also serves as a water separator, the moisture in the compressed air condensing and falling to the bottom of the tank, where it is drawn off or blown out at *X*. *F* is an air outlet into the pipe, *N*. The air passes through the pipe, *N*, into the sand hopper, *A*, to maintain a uniform pressure on the sand, the air being controlled by the cock, *T;* it then passes into a ⅛-inch injector pipe, *E*, and into mixing chamber, *P*. Sand and air pass through pipe, *Q*, and a ¾-inch hose, *H*, to the nozzle. The cock, *R*, on pipe, *N*, regulates the flow of air into the mixing chamber and thereby regulates the amount of sand flowing to the nozzle. When the operator shuts off the air by closing cocks, *R* and *T*, valve, *G*, must be opened to allow the compressed air in the sand hopper to escape before refilling. This valve also serves as a sand economizer, inasmuch as by opening it after shutting off the air from the compressor, the sand flow immediately stops. The air at high pressure in mixing chamber, *B*, passes through a 1-inch hose at *S*, to the nozzle.

The air at high pressure from the machine enters the nozzle through a 1-inch hose at *K*. The sand from the machine is carried through the ¾-inch hose and enters the nozzle through a ¼-inch sleeve at *L*. The air entering at *K* passes through a 3/16-inch high velocity turbine air jet, *M*, and meets the sand in the removable cone, *D*. The sand and air pass out through a ¼-inch orifice, *F*. Inasmuch as the end of the cone is subjected to the greatest wear, a tip ¼ inch in diameter is slipped in to protect it. These tips are easily inserted and their cost is nominal. The cone is held in position on the nozzle by a hinged ring held in position by a screw lock. The sand sleeves are held in position by a screw and a half turn will loosen the sleeve so that it can be easily slipped out. Inasmuch as air alone passes through the high velocity turbine air jet it will not become enlarged, as would be the case if sand were passing through this opening, and the air pressure and air consumption, therefore, always will remain constant. The same applies to the injector pipe, *E*, and the pressure and volume of air entering the mixing chamber always will remain uniform. The total amount of air passing through these points gives the total air consumption and the wear at the nozzle will not effect the amount of air used.

The following table shows the discharge in cubic feet of free air per minute and reflects the economy in air consumption. The horsepower required to operate the machine at various pressures also is noted:



EVANS HIGH-PRESSURE SAND BLAST MANUFACTURED BY THE CARTER METALS CLEANING CO.

Pressure.	Air, cubic feet.	Horsepower.
80	69	12½
90	76½	15
100	83	17½

The sand is forced through the tip of the nozzle by the pressure of air flowing through the turbine air jet, supplemented by the flow through the injector. The sand thereby acquires a centrifugal movement which causes it to whirl as it leaves the nozzle, and it is claimed that great cleaning efficiency thereby is obtained. This high pressure and sand blast machine is adapted for cleaning all kinds of metals from brass to the hardest steel. It is claimed that in cleaning steel castings it will quickly remove the outer crust of sand, as well as the sand fused onto the casting, which frequently involves the use of pneumatic chippers to remove. It also can be employed in removing mill scale, paint, etc., from structural steel or steel plates.

Hardness Testing Machine

A portable machine for testing the hardness of metals by the Brinell method has recently been placed on the market by H. A. Elliott, 507 Majestic building, Detroit. The hardness is measured by making an impression in the sample with a 10-millimeter ball under a pressure of 3,000 kilograms and comparing it with a standard impression made under similar conditions.

Fig. 1 shows the machine ready for the test with the lever raised and resting on the shaft. The sample is placed on the table which is then screwed up until the piece is in contact with the ball and force is slowly applied to the lever until 3,000 kilograms are registered on the small manometer in the frame. Under normal conditions it is necessary to move the lever about 45 degrees. The

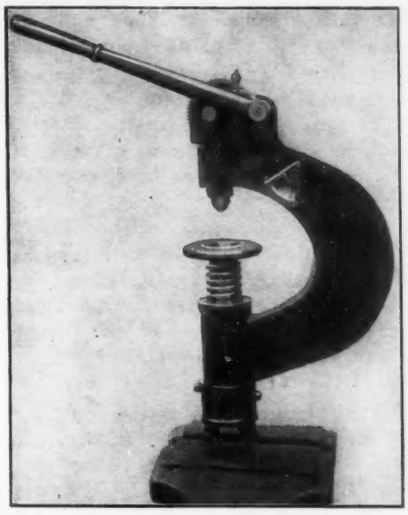


FIG. 1—DERIHON HARDNESS TESTING MACHINE

diameter of the impression made in the sample is measured and this figure compared with the diameter of the standard impression gives the relative hardness.

The pressure is measured by the deflection of the frame which is so shaped as to have a maximum elasticity. The distortion of frame is proportional to the force applied to the lever and is indicated by the manometer which is calibrated to read in kilograms. The maximum deflection does not exceed 15 millimeters. The frame is made of air-hardened, chrome-nickel steel having an elastic limit of 242,000 pounds per square inch.

Through long continued use or accident, the frame may assume a permanent set which would result in inaccurate pressure readings. In this case, the necessary adjustment may

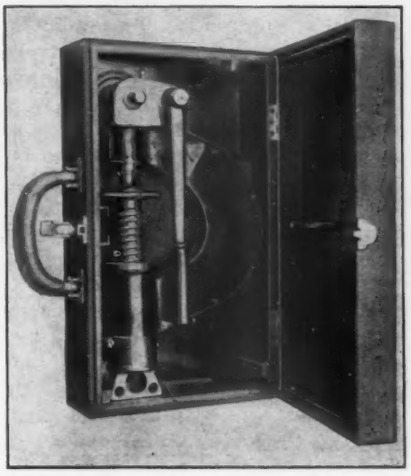


FIG. 2—MACHINE PACKED IN CASE

be made by making a standard impression in the standard piece and simultaneously bringing the needle of the manometer over the 3,000 mark by means of a small adjusting screw, the machine is so constructed that adjustments of this kind are rarely necessary.

Peterson-National Co. Absorbed

The Cataract Refining & Mfg. Co., Buffalo, manufacturer of core oils and core compounds, has taken over the business of the Peterson-National Core Oil Co., and hereafter will manufacture the different grades of liquid core compounds heretofore made by the Peterson-National company. The Cataract Refining & Mfg. Co. operates two plants at Chicago and Buffalo, respectively, and is in position to make prompt shipments of any size order from a barrel to a tank car. The manufacture of the parting compound heretofore made by the Peterson-National company also will be continued and its trade name has been changed from Peterson parting to Bison parting.

Woodison Co. Expands

The E. J. Woodison Co., Detroit, manufacturer and dealer in foundry supplies and equipment, recently completed the installation of a buffing composition plant for manufacturing compositions for finishing nickel plate on brass, nickel plate on iron and other material such as tripoli, crocus, emery cake, coloring composition, etc. The Woodison company also is placing on the market a metal rim riddle with an adjustable bottom. These riddles are being made in two sizes, namely, 18 and 20 inches in diameter, provided with both galvanized and brass bottoms or sieves.

Heavy Rolled Steel Flasks

Some extra heavy reinforced rolled steel flasks have recently been constructed by the Sterling Wheelbarrow Co., West Allis, Wis., for the McKeesport foundry of the National Tube Co. and the Pearl Harbor, Hawaii, foundry of the United States government. The corners of the flasks are reinforced with heavy malleable castings which are provided with holes in which handles may be screwed and also with lugs over which U-shaped clamps are fitted to hold the cope and drag together when rolling-over the mold. The flask pins are carried in heavy malleable iron plates riveted to the ends of the flask and malleable trunnions are similarly riveted to the sides. The tendency of the sides to spring under pressure is counteracted by reinforcing each section with a center rib of more than the double

REINFORCED CIRCULAR AND RECTANGULAR STEEL FLASKS

thickness of the rest of the metal. Both circular and rectangular flasks of this type are shown in the accompanying illustration.

Bloomsbury Graphite Co.

The Bloomsbury Graphite Co., Bloomsbury, N. J., recently organized, has taken over the plant and business of the Bloomsbury Facing Mills operated since 1882 by J. T. Hoffman. The product of these mills, consisting of a varied line of graphites and foundry facings, will be sold direct to consumers. Edwin R. Wolverton, who has been connected with T. P. Kelly & Co., New York City, over a period of 10 years, will direct the affairs of the Bloomsbury Graphite Co.

Too Much Coke on the Bed

By W. J. Keep

Question.—We are experiencing considerable difficulty in the operation of our cupola. The iron does not come down until 30 minutes after the blast is put on. We melt from 7,000 to 10,000 pounds per heat. The cupola lining after each heat is cut considerably and must be repaired each week. Our cupola is 31 inches inside of lining and the height from the sand bottom to the tuyeres is 13 inches. The cupola is equipped with six tuyeres, 8 x 9 inches. The bed charge of coke weighs 1,000 pounds and the subsequent charges consist of 1,500 pounds of iron and 150 pounds of coke. Fifteen per cent oyster shells also are charged for a flux. The blast pressure is 9 ounces. Our metal analyzes 2.40 to 2.60 per cent silicon and is sufficiently hot for our use. We also would like to know how we can charge steel scrap with iron that analyzes 2.30 to 2.70 silicon.

Answer.—The dimensions of your tuyeres undoubtedly are wrong, for if these are 9 inches wide they should not be more than 4 inches high. However, if the dimensions are correct, you can cast six pieces of iron, 9 inches long, 4 inches deep and 3 inches wide, to be inserted inside of the tuyere openings, which will reduce their area. It would be advisable to place these castings in the upper part of the openings if they possibly can be held in that position. You also could make these castings 3 inches thick with a ½-inch foot on each side, 5 inches high. This would make each tuyere 5 inches high and 8 inches wide. However, after a trial I think you could add the other inch to the filler and thereby reduce the opening to 4 x 8 inches. This would leave the height above the sand bottom 13 inches, as you now have it.

Make a mark on the inside of the cupola 18 inches above the top of the tuyeres as you finally have these arranged. Measure the distance from this mark to the sill of the charging door. Take a piece of ⅜ inch round steel, 4 feet longer than the distance from the mark in the cupola to the bottom of the charging door and bend a section 2 feet long at each end, at right angles, similar to a letter Z. Place 1,000 pounds of coke on your scaffold and after lighting the wood in the furnace, which should be done two hours before the iron is needed, charge the amount of coke that you think is required. However, do not let the coke burn too fast. After 500 pounds of the coke is well ignited and after all of the wood has been burned out, hang the bent rod on the bottom of the charging door sill and add coke until the bed is as high as the lower end of the rod. This should be done about 45 minutes before the iron is to be tapped. Then charge iron and fill the cupola as you previously have done. Weigh the remainder of the coke left on the scaffold and then you readily can tell how much is required for the coke bed. The reason that 30 minutes are required for your iron to come down is because it takes that long to burn the surplus coke of the bed and to permit the iron to reach the melting zone. Iron should melt as soon as the blast is put on and it should be tapped out in eight to 10 minutes thereafter.

Personal

Charles Schutte has been appointed brass foundry foreman of the casting plant operated by the McNab & Harlin Mfg. Co., Paterson, N. J.

E. M. Simon has been appointed superintendent of the Union Malleable Iron Co., East Moline, Ill., to succeed J. A. Pope, recently resigned.

The Terry Steam Turbine Co., Hartford, Conn., announces the appointment of H. A. Rapelye as sales engineer of the Pittsburgh district with offices in the Oliver building.

Frank E. Leavitt, formerly affiliated with the United States Radiator Corporation, has been appointed manager of the Shirley Radiator & Foundry Co., Indianapolis.

C. P. Karr, associate physicist of the Bureau of Standards, with headquarters at Pittsburgh, will be transferred to Washington, D. C., on April 1.

H. N. Hudson, formerly vice president of the Hoyt Metal Co., St. Louis, has been appointed general sales manager of the white metal department of the Great Western Smelting & Refining Co., Chicago.

J. M. Litchfield, formerly affiliated with the Magnolia Metal Co., New York, has been appointed eastern representative of the Electric Smelting & Aluminum Co., Lockport, N. Y.

Thomas Haddow has been appointed foreman of the plating and finishing department of August Goertz & Co., Inc., Newark, N. J. Mr. Haddow formerly was affiliated with Adolph Neubeck, Buffalo.

C. S. Weigert, who has a wide acquaintance in the iron and brass foundry trade, is now affiliated in a sales capacity with the Hill & Griffith Co., Cincinnati, manufacturer of foundry facings, supplies and equipment.

C. E. Knoeppel recently has withdrawn from the firm of Van Gelder, Knoeppel & Young, Inc., 55 Liberty street, New York City, and is individually engaged in consulting service, covering organization, time and motion study, planning and routing stores, cost, wage payment and standardization methods, with an office at 15 Dean street, Worcester, Mass.

A. S. Baldwin, general manager of the Alberger Pump & Condenser Co., Newburgh, N. Y., during the last three years, has tendered his resignation, effective April 1. Prior to his affiliation with the Alberger Pump & Condenser Co. Mr. Baldwin was superintendent of the shops of the Driggs Seabury Ordnance Corporation, Sharon, Pa., for a period of four and one-half years, and prior to that time he was superintendent of the American & British Mfg. Co., Bridgeport, Conn.

Dr. Moldenke Resigns

Dr. Richard Moldenke, secretary and treasurer of the American Foundrymen's Association, has resigned, effective April 1, and A. O. Backert, editor of THE FOUNDRY, *Cleveland, has been appointed his successor by Alfred E. Howell, president of this organization. The office of the secretary and treasurer of the American Foundrymen's Association has been transferred from Watchung, N. J., to Twelfth and Chestnut street, Cleveland, where all communications hereafter should be addressed.*

The Cupola Bridging Problem

By W. J. Keep

Question.—We are experiencing considerable difficulty in operating our cupola, owing to the frequent bridging of the charges. Our average heat is 25,000 pounds, which is melted in two hours and 15 minutes. The blast is 12 ounces. We use 12 pounds of fluorspar after the fourth charge. The bed consists of 500 pounds of coke and 400 pounds of coal and on the bed 2,000 pounds of metal are charged. The subsequent charges consist of 2,000 pounds of metal and 200 pounds of coke. The height of the bed above the tuyeres varies from 18 to 20 inches.

Answer.—The conditions as you describe them seem to be ideal and your difficulties are due to your method of operation. Fluorspar is one of the best fluxes that you can use, but a flux is of little value other than to make the slag fluid so that it will

readily flow out of the cupola through the slag hole. It might be advisable to charge fluorspar with each charge of coke and to tap out the slag as soon as it appears at the tuyeres, which will be at about the third or fourth charge. If 12 pounds of fluorspar per ton of iron does not give a fluid slag, you will have to increase the amount used. Limestone, as a rule, does not contain more than 50 per cent of lime, but if it contains 70 per cent, you will not have to use more than 25 to 40 pounds per ton of iron. Marble chips generally contain more lime than quarried limestone. Since you are located near the coast, it might be advisable for you to try oyster shells for fluxing purposes. It also might be advisable for you to examine your coke for the reason that if it has not been burned sufficiently long, it will become plastic in the cupola, causing bridging, and after a time will prevent the blast from getting through the charges at a sufficient speed to melt the iron. The method of charging also should be investigated. Since your pig iron is in pieces about 4 inches square and 18 inches long, care should be exercised in charging the scrap so that pieces of the latter will not be of any larger dimensions than the pig iron. The metal also should be charged uniformly and care should be exercised not to leave openings through which the blast can pass at a faster rate than at other points. Under no condition shovel the dirt left from charging into the cupola, but pass it through a riddle and recover the iron that remains on the riddle mesh.

Exercise care in charging your cupola, using a good grade of coke, and by the adoption of other precautions you may be able to prevent bridging without resorting to the use of a slag tap hole. However, in all cupolas the the slag should be removed as rapidly as it is formed.

WHAT THE FOUNDRIES ARE DOING

Activities of the Iron, Steel and Brass Shops

The Nelson Foundry Co., North Milwaukee, Wis., has changed its name to the Badger State Foundry Co.

The Sterling Foundry Co., Sterling, Ill., whose plant was damaged by fire recently, is rebuilding.

The Ashland Foundry Co., Ashland, O., has increased its capital stock from $15,000 to $20,000.

The Nashua Iron Foundry Co., Nashua, N. H., commenced business recently. Henry Labine is general manager.

The Oneida Foundry Co., Oneida, N. Y., has leased the large plant which it built and equipped, to the Oneida Steel Pulley Co.

The Western Foundry & Machine Co., Okmulgee, Okla., has been incorporated with $50,000 capital by F. H. Cate, W. M. Rhodes and J. A. Cate.

The Aluminum Goods Co., Two Rivers, Wis., will award contracts for the erection of a three-story addition to its buffing and finishing departments.

Fred Weineck and J. Summerhays, Waterloo, Ia., have purchased and will operate the Olbrich foundry on East Fifth street, Cedar Falls, Ia.

The Reliance Foundry Co., Richmond, Ind., has leased a building at Seventeenth and F. streets and is equipping a foundry which will increase its capacity 50 per cent.

The Aylward Foundry Co., New Holstein, Wis., recently completed a new plant for the manufacture of gas engine castings and the first heat will be taken off about April 1.

The Wabash Foundry Co., Wabash, Ind., has been incorporated with $50,000 capital by Nelson G. Hunter, James I. Robertson and Charles H. Haas.

The plant of the Sandage Foundry Co., Oregon, Ill., has been sold to the Paragon Foundry Co., Chicago. Piano plates will be manufactured.

The Duchess Foundry Co., Poughkeepsie, N. Y., has been incorporated with a capital of $10,000 by Joseph Dufour, J. C. Van Zile and William Wagnitz.

J. P. Hughey and Charles Somers, Salisbury, N. C., have bought the foundry at Northwilkesboro, N. C., and will put it in operation.

The Bridgeport Foundry & Machine Co., Bridgeport, Conn., has filed a preliminary certificate of dissolution, signed by R. D. Whipple, Ralph H. Whipple and Charles N. Cheate.

Bondholders of the defunct Emaus Foundry & Machine Co., Emaus, Pa., have decided to accept the proposition of the R. Pennebacker Co., Allentown, Pa., for the purchase of the plant.

The Lansdale Foundry Co., Lansdale, Pa., has been incorporated with a capital of $25,000. The incorporators are F. H. Souder, Harvey S. Moyer, David Orr, M. S. Moyer and R. J. Vogel.

The Kramer Bros. Foundry Co., Dayton, O., advises it does not intend to build on the land recently bought from the C. W. Raymond Co. The Kramer company manufactures hardware specialties.

The D'Arcy Mfg. Co., Buffalo, has been incorporated with $25,000 capital to operate a foundry and machine shop. The incorporators are C. A. Yearke, J. C. Yearke and C. F. Yearke.

The Darlington Steel Casting Co., Darlington, Pa., recently organized, has secured the plant formerly operated by the United States Foundry & Furnace Co. and will manufacture steel castings.

The Florence Iron & Machine Works, Florence, S. C., a partnership formed by Richard P. Laughlin and George W. Laughlin, has purchased the old Florence Iron Works plant on West Front street, which they expect to operate.

The West Bend Aluminum Co., West Bend, Ind., has increased its capital stock from $50,000 to $75,000 and will erect a new plant for the manufacture of kitchen utensils and specialties. The building will be 60 x 250 feet and two stories high.

The Toronto Foundry & Machine Co., Toronto, O., has taken over the Henderson Foundry & Machine Co., that city, and the Tri-State Foundry & Machine Co., New Cumberland, W. Va. The new company is incorporated for $125,000 and will manufacture pipe machinery and do general foundry work.

The Myerstown Foundry & Mfg. Co., Myerstown, Pa., has leased the plant formerly occupied by the Stoever Foundry & Mfg. Co. and will manufacture the same line of castings formerly made by the Stoever company. The new firm was organized by Leighton F. Krum, Frank K. Lutz and Edward S. Karsnitz.

The Railway Materials Co., Chicago, has started work on remodeling the former Wisconsin Central railroad shops at Stevens Pt., Wis., into a brake shoe foundry and expects to begin operations shortly. Equipment has been ordered and will be installed as soon as possible. A contract has been entered into with the Stevens Point Light & Power Co. for the supply of current.

New Construction

The Homers Motor Co., Los Angeles, Cal., contemplates the erection of a new foundry.

The Oklahoma Iron Works, Tulsa, Okla., will erect a foundry.

The Mechanics Iron Foundry Co., 88 Reading street, Roxbury, Mass., will erect a one-story addition.

The Iron City Foundry Co., Lebanon, Pa., manufacturer of grey iron castings, will rebuild its plant, recently burned.

The J. Davenport Co., Stamford, Conn., manufacturer of piano plates, contemplates the erection of a new foundry.

The Wheeling Mold & Foundry Co., Wheeling, W. Va., recently completed the erection of a foundry especially equipped for casting rolls.

The Rutland Foundry & Machine Co., Rutland, Vt., has acquired a site at Post and South streets on which a shop will be erected, 49 x 100 feet.

Robinson & Co., founders, Richmond, Ind., advise that they do not plan to enlarge their plant in the immediate future. Later on some extensions may be made, but nothing definite is under way at present.

The Arneson Foundry Co., Kenosha, Wis., will build an addition to its iron foundry which will be devoted entirely to the manu-

facture of steel castings by the converter process. The addition will be 50 x 90 feet. All of the equipment for this plant was furnished by the S. Obermayer Co., Chicago.

The Hempfield Foundry, Inc., Greensburg, Pa., has awarded the contract for the erection of a steel and concrete addition to its foundry.

The San Pedro Foundry & Machine Co., Los Angeles, Cal., will build a $25,000 foundry and machine shop, and will establish machine and repair shops, a boat building plant and marine railway.

The plant of the Central Machine & Foundry Co., Marion, Ind., has been purchased by the Marion Machine & Foundry Co. and the melting equipment will be increased by the installation of another cupola.

The West Side Foundry Co., Kansas City, Kan., has leased a site at the foot of Nebraska avenue on which it will erect a malleable iron foundry. George Bemarkt is manager.

About $25,000 will be expended in improvements to the plant of the American Malleable Castings Co., Marion, O. An office building and a 30 x 175-foot shop of brick and steel, are to be erected.

The Bellwood Mfg. Co., Bellwood, Pa., contemplates the erection of a steel foundry in the near future, for which it will require complete equipment. The company will not be ready for several months to place its inquiries.

The Madison Foundry Co., Cleveland, will erect an addition to its plant at 935 Addison road. The structure will be in two parts, 59 x 120 feet and 45 x 97 feet, and will cost approximately $10,000. H. G. Slatmeyer is the contractor.

The Allyne-Ryan Foundry Co., Cleveland, will erect an addition to its plant on Aetna road. The new building will be of brick construction, 112 x 120 feet, two stories high, and will cost about $18,000. Plans were prepared by the Forest City Engineering Co., Cleveland.

Among the Brass Founders

The Central Foundry has erected a brass and aluminum shop at Syracuse, N. Y.

The Wellsville Electric Plating Works, Wellsville, N. Y., contemplates the erection of a brass foundry.

The Aluminum Casting & Brass Mfg. Co., Detroit, will erect a foundry on St. Aubin street.

The firm name of the Murphy-Potter Co., Detroit, has been changed to the Brass & Aluminum Foundry & Machine Co.

The Aluminum Castings Co., Cleveland, has discontinued its foundries at Syracuse, N. Y., New Kensington, Pa., and its plant at 772 Bellevue avenue, Detroit.

The Continental Brass & Foundries Co., St. Louis, has been incorporated with a capital of $25,000 by G. D. Klemme, Ferdinand Messmer and Joseph Messmer.

At the recent annual meeting of the H. Mueller Mfg. Co., Ltd., Sarnia, Ont., Can., the capital stock was increased from $300,000 to $500,000, and orders for new machinery and equipment, aggregating $25,000, were placed.

The Racine Aluminum Shoe Co., Racine, Wis., manufacturer of aluminum sole shoes, has increased its capital stock from $25,000 to $50,000 for the purpose of extending its business and enlarging its works.

The American Brass Foundry Co., Milwaukee, has increased its capital from $5,000 to $12,000 to provide funds for the purchase of additional equipment. This company manufactures aluminum castings and bearing bronzes for motor cycles.

The C. R. Breuer Smelting & Refining Co., Cincinnati, has been incorporated with $50,000 capital to engage in the smelting and refining of non-ferrous metals. The incorporators are F. Eggard, Joseph P. Feister, Charles O. Bryson, C. R. Breuer and C. J. McDearmitt.

NEW TRADE PUBLICATIONS

SHOVELS.—The Conneaut Shovel Co., Conneaut, O., has issued a catalog describing its line of hand shovels.

CRABS AND WINCHES. — The Brown Hoisting Machinery Co., Cleveland, has issued an illustrated pamphlet describing its safety crabs and winches.

BUCKETS.—The Hayward line of orange peel and clam shell buckets is illustrated and described in a recent publication of the Hayward Co., 50 Church street, New York.

CRANES. — A 20-page bulletin issued by the Pawling & Harnischfeger Co., Milwaukee, is devoted to its new type "H" crane, which is described in detail and all of the various parts are well illustrated.

PYROMETERS.—The Stupakoff Laboratories, Pittsburgh, have issued an attractive pamphlet devoted to pyrometers and galvanometers under the title of "Pyrometer Facts." The booklet contains information of value to pyrometer users.

SMALL MOTORS.—A 16-page bulletin, recently issued by the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., is devoted to small motors for operating small equipment. General views are included showing the Westinghouse company's department for assembling these machines and their construction is described in detail.

FIRE BRICK.—A 36-page catalog issued by the E. J. Woodison Co., Detroit, is devoted to fire brick for foundry, steel plant, coke oven and boiler use. Various shapes are illustrated with dimensions, and tables are included which will prove of value to all users of brick and clay. The Woodison company, in addition to fire brick, is in position to furnish fire clays, fire sands, ganister, fire cement, kaolin, etc.

CRANES.—A 40-page bulletin recently issued by the Shepard Electric Crane & Hoist Co., Montour Falls, N. Y., is devoted to this company's extensive line of traveling cranes. In addition to detailed descriptions of the cranes and their appurtenances, including trolleys, trucks, controllers, etc., a large number of service views are included, which clearly illustrate the adaptability of the handling equipment built by this company.

TRAVELING CRANES.—A 64-page catalog devoted to its extensive line of electric traveling cranes, hand cranes, hoists and other handling machinery, has been issued by the Northern Engineering Works, Detroit. In addition to the detailed views of the various parts of these cranes, hoists, etc., numerous service views are included, showing the application of these cranes in various industrial plants, such as foundries, machine shops, railroad repair shops, steel plants, wire mills, etc.

TURBINES.—An eight-page bulletin issued by the Terry Steam Turbine Co., Hartford, Conn., is devoted to this company's new type of return flow machine. This type is particularly well adapted for low and mixed pressure work, only one rotor being required for the high-pressure velocity stage element. The low pressure elements are in a removable drum which is sectionalized into small, removable pieces that carry the stationary blades. Various views of this machine are contained in this bulletin and details of its construction are included.

LOCOMOTIVE CRANES.—An exceedingly handsome, well-arranged and well-illustrated 72-page catalog, printed in two colors, devoted to locomotive cranes, has been issued by the Browning Co., Cleveland. The crane is described in detail in the first section of the catalog and this is followed by a magnificent pictorial display of these cranes in use at blast furnace plants, ore docks, steel mills, foundries, etc. The adaptability of this type of crane covers an exceedingly wide range and their territorial spread of application extends from the iron ore mines in the Lake Superior region to the ditch of the Panama canal.

BORING AND DRILLING. — "Difficult Drilling and Boring Made Easy" is the title of a handsomely illustrated and well-arranged 30-page booklet issued by the Pawling & Harnischfeger Co., Milwaukee, which is devoted to the work that is being done in various plants throughout the country on the horizontal drilling and boring machines built by the Pawling & Harnischfeger Co. Following a detailed description of these machines, service views are included showing the various lines of work to which this type of machine is adapted. These views were made in various plants in which these machines are installed and clearly indicate the wide field of application for this tool.

LOCOMOTIVE CRANES.—A handsomely illustrated, 56-page catalog, issued by the Industrial Works, Bay City, Mich., is devoted exclusively to locomotive cranes adapted for construction and railroad purposes and data are included regarding various accessories, such as clam shell buckets, lifting magnets, special cars, booms and attachments. The catalog is printed in three colors and contains a large number of illustrations of locomotive cranes in various service throughout the country. These views graphically illustrate the adaptability of these machines for various classes of work. The cranes built by this company are described in detail and a partial list of railroads, manufacturers, contractors and others using these cranes is included.

OILSTONE GRINDERS.—A 32-page catalog issued by the Mummert-Dixon Co., Hanover, Pa., is devoted to this company's extensive line of oilstone grinders. These machines are designed and built for sharpening edge tools, general grinding, beveling knives, etc., and they are built in all sizes to meet the requirements of every type of woodworking shop and industrial training institution. The oilstone wheels are placed in a pan designed in such a manner that the stones are constantly kept in an oil bath. Appliances to keep the stones uniformly saturated and to prevent the oil from flying off are placed at the back of the stones. The machines are provided with tool rests and when desired are arranged for motor drive. The catalog is well illustrated and contains details of the various grinders built by this company.